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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 111
APRIL, 1921

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TRANSACTIONS
OF THE
EIGHTEENTH ANNUAL CONFERENCE
OF STATE AND TERRITORIAL HEALTH OFFICERS WITH THE UNITED STATES PUBLIC HEALTH SERVICE

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HELD AT WASHINGTON, D C.
MAY 26 AND 27, 1920

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LETTER CALLING THE CONFERENCE.

TREASURY DEPARTMENT,
BUREAU OF THE PUBLIC HEALTH SERVICE,
Washington, March 15, 1920.

DEAR DOCTOR: I have the honor to inform you that the eighteenth annual conference of State and Territorial health authorities with the United States Public Health Service will be held at Washington, D. C., May 26 and 27, 1920, beginning at 10 a. m., May 26. It is urged that your State be represented by an official delegate, as important State and National public health matters will be brought before the conference for action. Although but one delegate from each State has the privilege of voting, a cordial invitation to attend the conference and take part in the discussion is extended to any other representatives which your State may care to designate.

I take pleasure in inviting you to suggest topics which in your opinion should be discussed at the conference.

It is requested that you advise me as soon as practicable as to the name of the official delegate selected to represent your State.

Very truly, yours,

HUGH S. CUMMING,
Surgeon General.

STANDING COMMITTEES.

Morbidity Returns.

Dr. Eugene R. Kelley, chairman.
Dr. C. Hampson Jones.
Dr. B. S. Warren.

Sanitation of Public Conveyances.

Dr. Oscar Dowling, chairman.
Dr. J. N. Hurty.
Dr. T. B. Beatty.
Dr. W. F. Cogswell.
Dr. Victor G. Heiser.

Interstate Quarantine Regulations.

Dr. John S. Fulton, chairman.
Dr. E. G. Williams.
Dr. C. E. Smith, jr.
Dr. S. J. Crumbine.
Dr. T. B. Beatty.
Dr. A. J. McLaughlin.

Rural Sanitation.

Dr. W. S. Rankin, chairman.
Dr. C. E. Dalton.
Dr. J. A. Hayne.
Dr. L. L. Lumsden.

Trachoma.

Dr. John McMullen, secretary.

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Roll call of delegates.
Appointment of committees.

REPORTS OF STANDING COMMITTEES.

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Sanitation of public conveyances: Dr. Oscar Dowling.
Interstate quarantine regulations: Dr. John. S. Fulton.
Rural sanitation: Dr. W. S. Rankin.
Trachoma: Dr. John McMullen.

SPECIAL REPORT.

Progress report of commission appointed by the Surgeon General to study the problem of sanitary disposal of human excreta in unsewered communities; Prof. C. W. Stiles.

NEW BUSINESS.

Initiation of a Nation-wide health campaign.

Public health administration:
  Discussion of data obtained from questionnaire concerning whole-time county health officers in the various States.
Child Hygiene:
  Discussion of Fess bill for physical education promoted by the national physical education service.
  Discussion of Sheppard-Towner bill for Public protection of maternity and infancy.
  Report of child hygiene activities of the service.

Framing of a National and State policy for the production of clean milk in adequate quantities.

Rural sanitation:
  Determination of a workable plan of presenting financial equivalents in county health work.
  Rural sanitation with special reference to county demonstration work with small budgets in Virginia.
  Discussion of cooperative demonstration work in rural sanitation in Virginia.

Endemic index and communicable disease control.

Better morbidity reports.

Coordination of effort and promotion of efficiency in field of sanitary engineering.

Malaria:

Mosquito film. Produced by the Public Health Service in cooperation with the Reclamation Service, Bureau of Fisheries, and the Bray Studios.

Extension of cooperative malaria work.

Migration of tuberculous persons.

Provision for lepers.

Venereal diseases:

Control of venereal diseases with reference to the relation of the United States Public Health Service to States and cities in handling this problem.

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EIGHTEENTH ANNUAL CONFERENCE OF STATE AND TERRITORIAL HEALTH AUTHORITIES WITH THE UNITED STATES PUBLIC HEALTH SERVICE.

TRANSACTIONS.

MORNING SESSION, WEDNESDAY, MAY 26, 1920.

The eighteenth annual conference of State and Territorial health authorities with the United States Public Health Service was called to order at 10 o'clock, a. m., May 26, 1920, at the branch building of the Public Health Service, First Street NW., between B and C Streets, Washington, D. C., Surg. Gen. Hugh S. Cumming presiding.

The following persons were present during the conference:

REPRESENTATIVES OF THE STATE HEALTH DEPARTMENTS.

Alabama: S. W. Welch, G. H. Hazelhurst.

Arkansas: E. P. Irwin, M. D.

California: Dr. John Thames, M. Z. Bair, and Dr. Irving R. Bancroft.

Colorado: Dr. R. S. Drinkwater.

Connecticut: Dr. John T. Black.

Delaware: Dr. C. H. Wells, Dr. Wm. P. Orr.

District of Columbia: Dr. John L. Norris.

Florida: Dr. G. W. Simons, jr. (representing Dr. Ralph Green), Dr. W. W. McDonell.

Georgia: Dr. T. F. Abercrombie.

Hawaii: Dr. F. E. Trotter.

Idaho: Dr. Ernest E. Laubaugh.

Illinois: Dr. C. St. Clair Drake, Dr. G. G. Taylor, Dr. H. F. Furgeson.

Indiana: Dr. Hugh A. Cowing, Dr. J. N. Hurty.

Iowa: Dr. W. S. Conklin.

Kansas: Dr. B. K. Kilbourne (representing Dr. Crumbine).

Kentucky: Dr. A. T. McCormack.

Louisiana: Dr. Oscar Dowling.

Maryland: Dr. John S. Fulton.

Massachusetts: Dr. Howard B. Streeter, Dr. B. W. Carey.

Michigan: Dr. J. M. Byington, Dr. E. D. Rich, Dr. R. M. Olin.

Minnesota: Dr. Charles E. Smith, jr.; Dr. H. A. Whittaker, Dr. H. G. Irvine.

Mississippi: Dr. W. S. Leathers.

Missouri: Dr. George H. Jones, Dr. R. L. Russell.

Montana: Dr. W. F. Cogswell.

Nebraska: Dr. I. H. Dillon, Dr. P. H. Bartholomew.

New Jersey: Dr. R. B. Fitz-Randolph.

New Mexico: Dr. C. E. Waller.

New York: Dr. Mathias Nicoll, jr.; Dr. J. S. Lawrence, Dr. L. I. Harris.

North Carolina: Dr. W. S. Rankin, H. E. Miller.

North Dakota: Dr. I. W. Mendelson (representing Dr. McGurren).

Ohio: Dr. R. G. Leland, Dr. Allen W. Freeman.

Oklahoma: Dr. J. C. Mahr.

Pennsylvania: Dr. C. A. Emerson, Dr. S. Leon Gans, Dr. E. S. Eberhart.

Rhode Island: Dr. B. U. Richards, Dr. J. E. Kearney.

South Carolina: Dr. James A. Hayne, Dr. C. V. Akin, E. L. Filby.

Tennessee: Dr. Olin West, W. J. Miller, Dr. G. A. Hays.

Texas: Dr. C. W. Goddard, Dr. Oscar Davis, Dr. V. M. Ehlers.

Virginia: Dr. E. G. Williams, Dr. Roy K. Flannagan, Richard Messer.

Washington: Dr. John B. Anderson, Dr. J. B. Capron.

West Virginia: Dr. S. L. Jepson, Dr. F. F. Farnsworth, E. S. Tisdale.

Wisconsin: Dr. W. F. Whyte, Dr. C. A. Harper, Dr. J. W. Heinker, Dr. Robert Olsen.

REPRESENTATIVES OF THE UNITED STATES PUBLIC HEALTH SERVICE.

Surg. Gen. Hugh S. Cumming.

Asst. Surgs. Gen.: H. R. Carter, C. C. Pierce, J. W. Schereschewsky, A. J. McLaughlin, R. H. Creel, and B. S. Warren.

Asst. Surg. Gen. (reserve): Taliaferro Clark.

Directing zoologist (reserve): C. W. Stiles.

Surgs. L. L. Lumsden, John McMullen, G. W. McCoy, L. D. Fricks, F. C. Smith.

Asst. Surg. R. B. Norment, jr.

Passed Asst. Surgs. C. P. Knight, Lydia A. De Vilbiss.

GUESTS.

Dr. John A. Ferrell, International Health Board, New York City.

Maj. L. G. Mitchell, Army Dental Corps.

Dr. M. M. Seymour, Canada.

OPENING REMARKS BY THE SURGEON GENERAL.

Gentlemen, I take pleasure in opening the eighteenth annual conference of the State and Territorial health authorities with the United States Public Health Service, and in doing so take the opportunity of thanking you for coming here. In view of the fact that you have already given me the pleasure of addressing you, I will not trouble you any further. We are going to have the pleasure of having the meeting formally opened by the chief of the Public Health Service, Assistant Secretary Moyle, of the Treasury Department.

We are extremely fortunate in having as director in chief of the service a man of such broad, comprehensive ideas, who is in such entire sympathy with the public health program which we all hope eventually to obtain.

OPENING ADDRESS BY THE HON. J. H. MOYLE, ASSISTANT SECRETARY OF THE TREASURY, IN CHARGE OF THE BUREAU OF PUBLIC HEALTH, ETC.

I sincerely wish that all the Surgeon General has said be true. So far as sympathy goes, he does not overstate the fact, because I never became interested in anything in my life in which my heart entered more fully and sympathetically than in the work of the Public Health Service.

Never before in the history of our country has public thought been directed more intelligently toward problems of public health than at present. The fact that human energy, that manhood is the great resource of our Nation, was thoroughly presented to the world when our boys came forward offering their lives in the greatest contest of all time, and such a large percentage of them were found not fit to fight because of physical disability. That condition has called attention to the extreme importance of public health.

When I first came to the Treasury Department I was very much surprised to find public health one of its activities, but public health after all is the great resource of our Nation, and its conservation, protection, and development of paramount importance. The United States Public Health Service, since I have been connected with it, now more than two and one-half years, has more than doubled its activities, chiefly because there has been forced upon the country the necessity of taking care of our boys who offered their lives in defense of our liberties. I had two of them in the fighting divisions of the Army; both came home—thank Providence—whole. I have little concern, as I have frequently said, about the able-bodied such as mine, not because I lack sympathy for them and appreciation of the great sacrifice they would have made, because I do not think there can be too much done for them; but I have not been concerned much about them in these times when there is abundant work; I can not conceive of anything too good for those who come back disabled. If my boys had come back disabled, I would have felt that our great Government was in duty bound and it should be a pleasure to do everything for them that could make their lives more pleasant, happy, and useful. To me it has been astonishing that more concern has been given to the able-bodied than to the disabled. Not because there has been any lack of sympathy. I do not want to criticize, or find fault, because I know something of the necessity of conserving and protecting that other great resource with which the Treasury Department is also deeply interested, our finances. I must not dwell long on that, as we no doubt all agree, but I do not hesitate to say that there is a duty which you are performing, but which you might possibly perform with greater energy and zeal, in the creation of a public sentiment at home that will compel greater contributions from the Treasury for the promotion of public health. It is a well-known fact that it is easier to get appropriations for taking care of hogs, rivers and harbors, and other infinitely less important resources than that of public health. The only way in which public health can be adequately advanced is by the creation of such a sentiment that there will be sooner or later a popular demand for a department of public health, a representative in the Cabinet of the President.

I understand that there are reasons, and excellent reasons, why there is not such an officer. I do not know what the views of my superior are on that question and I voice only my individual sentiments, which every American should always be free to express. If we can not have such a representative in the Cabinet, I have been wondering whether it would not be possible to have a Department of Public Health and Education combined, incorporating within it those intellectual and uplifting agencies that are consistent with it. What more important energies and elements of our Nation are there than those of education and health, and it seems to me that they might properly go together.

I must not detain you in the performance of your important work. God speed your efforts and the promotion of public health.

Dr. CUMMING. I may say that I have brought from Secretary Houston his best wishes; he was called to New York to-day, hence could not meet you.

The first thing in order, perhaps, is roll call of delegates. Before going into that, with your permission, I had thought of giving a short résumé of the activities of the service this morning, but I think those had better be brought out in the course of the meeting. It seems to me, however, pertinent to call your attention to two phases of public health activities during the past year which are not immediately represented on the program. With your permission I will discuss them.

There are times in every campaign, as you know, in every war, when crises occur at some particular point on the battle front, which rather disarrange your plans and compel you to withdraw forces which you intended to press to other points. Something of that sort at first view has occurred, I think, with the service. I refer to the question of the war risk insurance activities, which have occupied so much time and thought of the service. I confess that when I first came back to America and heard about the war risk and the number of officers it had taken, I rather felt it was a deviation from public-health activities, as some of you gentlemen do. On further thought I think it is a rather narrow view to take of the situation. In the first place I want to correct a misapprehension as regards the service. It did not go out to look for this thing, and it was a baby laid on our doorstep by Congress without any request on our part. But the duty is ours, the responsibility is ours. As the thing opens up more and more I can see in the war risk activities great possibilities from a strictly public-health standpoint. We are looking after 5,000,000 people. You may be astonished to know that approximately one-third of the cases are tuberculosis cases, and when the Federal Government looks out for one-third of all the tuberculosis cases from 5,000,000 of the population, you must confess that there is a pretty fair amount of public-health work involved. Another one-third, approximately, falls under the general head of neuropsychiatric cases, which are a burden on the local community and which appeal to us not from the standpoint of being contagious diseases, but potentialities of present and future generations. We are trying to get hospitals for these two types of cases particularly, and in the future I have a hope when the peak of the load of soldiers has been passed that these tuberculosis hospitals particularly will be of great and vital interest to us along other lines.

I shall not detain you any further but shall ask for a roll call of delegates. In this connection may I say that while Dr. Schereschewsky and I may have the pleasure of knowing you, we are getting pretty old and may not be able to recognize you here. So, for the benefit of the stenographers, will you please mention your name and State when you arise to make remarks?

(The secretary, Dr. Schereschewsky, called the roll by States, with the result heretofore noted.)

APPOINTMENT OF COMMITTEES.

The following committee on resolutions was appointed by the Surgeon General: Dr. C. St. Clair Drake, Illinois; Dr. J. A. Hayne, South Carolina; Dr. J. B. Anderson, Washington.

REPORTS OF COMMITTEES.

Dr. CUMMING. The next thing is the report of standing committees. The first one is the report on morbidity returns by Dr. Eugene R. Kelley.

Dr. CAREY. Owing to Dr. Kelley's recent illness he was unable to prepare this report.

SANITATION OF PUBLIC CONVEYANCES.

Dr. CUMMING. We will pass to the report of the committee on the sanitation of public conveyances, by Dr. Dowling, of Louisiana.

Dr. DOWLING. This report was made yesterday at the conference of State and provincial health authorities, and we submit this report now as amended by that conference, copy of which we feel sure will be placed in the hands of the Public Health Service. I move the adoption of the resolution and report (motion duly seconded and resolution and report unanimously adopted).

May I ask that this report be published at the very earliest convenience of the Public Health Service so that it may be distributed to all the health officers.

Dr. SCHERESCHEWSKY (in the chair). The next report is that of the committee on interstate quarantine regulations by Dr. John S. Fulton.

REPORT OF COMMITTEE ON INTERSTATE QUARANTINE REGULATIONS.

(Dr. Fulton submitted the following report:)

The substance of this report is a little surprising, and what I have to say I am afraid must be pretty nearly unpremeditated. There is, however, in this country a very great need for some form of interstate notification as a routine procedure, especially concerning the removal of cases of communicable disease and some things have been lost in the time of my memory which could have been and should have been, I think, in some sort, or under some other guise, kept up. I regret, for instance, that the United States Public Health Service has discontinued sending notifications to the State health officers of all States concerning the arrival by sea of persons affected with communicable diseases. Now, I got in my earlier days letters of that sort at intervals. The potential utility of these letters, for the country as a whole, was very high, I think. The security they offered to single States may have appeared somewhat small, but that is the case anyhow when you are dealing with relatively small numbers. I don't know when that practice started and I could not give even an approximate date when it ceased, but it did cease, and it was a form of interstate notification. Now the necessity for interstate notification has been impressed on me personally as well as officially in my experience in Maryland, in the year now current, or within a year of the present time; and I want to describe two of those instances just as illustrating the matter we have in hand which I am supposed to report on.

The State of Maryland found itself several months ago in one of the most humiliating situations that I think could happen from a public-health standpoint. We discovered in the State board of health office one day that an outbreak of scarlet fever had occurred in a large boarding school in one of the Maryland counties; that almost as soon as recognized, and without consultation with the local health officer or with the deputy State health officer or district or any other functionary whatever, the local health officer of that town—and I may say the incident occurred just outside of the jurisdiction—sent several hundred persons to their homes without notice to anybody at all. A couple of days after that it was necessary for me to write letters—and they were pretty humble letters, too—to 11 different officers in the United States, telling them that persons who might have been exposed to scarlet fever and who should be considered scarlet-fever contacts had been sent into their States by the State health authorities of Maryland. We apologized very humbly indeed for such a thing, which should have been entirely impossible. I hope all of the 11 men who got those letters are here present and will construe what I am saying without very much sign of embarrassment—construe it as a very humble apology for the occurrence of any such incident. There must be five or six of them here now. One thing struck me about that incident. After I had written these letters all over the country it occurred to me that I had been a health officer for 20 years, and I had never received a letter like that in my life. Is it possible that occurrences of that sort and that magnitude have not been noted in any other State, or have we been fortunate not to have such things brought to our attention by the failure of accidents like that to result in infectious disease? That certainly was one of those incidents which makes you think you have no national organization in your State.

The next incident that I want to describe does not put me in quite that position, but it does put another State in somewhat the same position. At the present time we are negotiating a tolerably stiff outbreak of smallpox in one of the counties of Maryland. This originated in a county in Delaware, which was able to drive it out of its borders. The constituted health authorities of Delaware were able to declare their total independence and assume all the responsibility to the rest of the State of Delaware and to all the adjoining States. A very dangerous situation arose, because the event proved if they had inclined to control the situation they were unable to do so, and in the course of several months—eight or nine months—it has just been found protruding itself into the State of Maryland. A thing of that sort should be avoided. I also mention an incident which shows a disposition to find some way of doing this thing right. The necessity of notifying sick people, if need be, arose in this fashion: After the very humiliating outbreak of scarlet fever in Maryland, which involved me with 11 different States, there was an outbreak in a school in Pennsylvania, and the health officer of that district must have thought that he had a duty to perform when he was going to release a lot of children from that school and distribute the pupils. He did it intelligently. He made a segregation before he sent those people off to their trains, he took the names and addresses of those who were leaving, and he wrote me a letter saying that he had sent certain ones into the State of Maryland. Now, everybody can see a fault in that procedure. He had handled the situation in a proper fashion, with the exception that his letter (if he were going to use the letter) should have preceded the act of sending those people into my State. However, it seems a very encouraging incident, indeed, and that too was novel, not unique, but relatively novel in my experience.

The practical suggestions to be drawn from the above incidents are that there is necessity for some kind of interstate notification; and that interstate notification must take its character from the necessities of the case when the radius is shortest, say the movement of the sick people within the State. We have used a practice in Maryland for a good many years which works very easily indeed and it is always possible to move a sick person or a contact person with no more delay than is required to telephone from the county health officer, where a journey is to be begun, to the State board of health and through that to the county health officer where the journey is going to end, and those things are effected with consent and with knowledge in a very short time indeed, ordinarily in half an hour by telephone, and confirmed in writing. We have been doing those things. The State board of health has regulation authorizing things of that sort. The biggest radius is the diameter of the State; but the movements in general are for rather short distances and they do need to be provided for in simple and practical fashion, because unless they are so handled these transportations occur without knowledge, sometimes by fraud, and sometimes with a great deal of danger. This regulation system has been in operation for quite a number of years in the State of Maryland. It does contain the principle upon which the transportations should occur. That man in Pennsylvania was only about 10 or 15 miles away from the deputy State health officer of the Maryland State district to which those people were going. It wasn't a large school and not a large number of pupils were coming in. I do not know to a certainty whether if the thing had been going on the other way, he would have applied the practice we have in mind, but I imagine he would. However, there is no evidence at the present time that we have a general understanding or general practice concerning such questions as that; and I conceive that country-wide notification through the Public Health Service is nothing like as laborious as the size of this country at first blush would lead you to conceive.

I conceive the bulk of transportation and the notification involved are of short radii and cover a very short time. Of course we want interstate notifications for the longest radius and the longest time. We want to know about current morbidity at all times. Not all over the country, necessarily; I don't care about California. I do care about Virginia and West Virginia and Delaware and these things I think should be provided. I am inclined to think they will not be provided—not perfectly, nor with even a very high grade of efficiency—until the United States establishes in this country an area of registration for sickness. I don't know how many States do register morbidity with sufficient approximation and completeness to be considered to have what we would call a registration area for sickness. I am sure I could name seven or eight States that could do it. It doesn't matter how small the group is, theirs is the duty of beginning this whole movement, and all of these simple questions can be handled easily enough inside of the State and can be handled across State borders readily. So far as this can be called a report at all, that seems to be one of the elements of it. The creation in the United States Public Health Service of a registration area for morbidity reports is very important. Current reports we get demonstrate that a registration area could be created. If it were, and if some simple practice for all the States for short radius were outlined, it is merely a matter of time and experience before we would be doing the thing in the large, just as well as we are doing it in the small, area.

(Dr. R. B. Norment was requested to open the discussion on the interstate quarantine regulations.)

Dr. NORMENT. I am rather embarrassed by being asked to discuss a question like this before a group of such experienced gentlemen, as I have had very little experience in doing this sort of work. I think, though, that all of us realize that State boundaries are only imaginary lines, and that certain things go on within the borders of States that have a very direct application across the borders in adjoining States. This instance of scarlet fever that Dr. Fulton has just mentioned is, of course, a thing which may happen in any place with a health officer sufficiently untrained in handling situations of this character. This sort of thing is probably going on continuously, causing interstate spread of communicable diseases. If a disease is being brought across a State border, there is often not enough cooperation between the field officers of the State health departments concerned, where they have such officers, to bring about a satisfactory interchange of information concerning the incidence of this particular disease. Of course, this implies a certain amount of Federal responsibility, as these are interstate matters. Nevertheless, it seems to me an arrangement could be made whereby closer cooperation could be obtained between the field forces of the State departments of health in regard to the interchange of sanitary information without transmission through the United States Public Health Service. It is often a rather cumbersome procedure to notify Washington and have Washington relay the information. Very often it is extremely important, especially if you have actual information concerning interstate movements of a case, that you get the information to its destination immediately.

I have in mind an instance of a case of smallpox traveling on a train of the Pennsylvania railroad. I learned that the case was on a certain train. I knew the time at which it would arrive at a certain point. I had a health officer meet that train and notify the conductor. The man was apprehended and taken from the train. Now, this, of course, is a somewhat unusual occurrence, but in all probability it is much more common than we realize. I have repeatedly had occasion to notice the progress of a wave of diphtheria or measles, or other communicable disease, from county to county within a State, and from the county of one State to the adjoining county of another State. This arrangement, which Dr. Fulton spoke of, between the State of Pennsylvania and the State of Maryland has worked out admirably in several instances. In one, a contact with a case of smallpox, the man was apprehended and the local health officer within whose jurisdiction he lived kept the man under observation until his period of incubation had passed. Interstate notification is, of course, an immense proposition, and would require an immense amount of work. Just how it could be done and just where the responsibility would lie, whether in volunteer cooperation of various health officers, or whether it would be necessarily under Federal supervision, remains to be worked out. It certainly seems that this idea should be applied intimately in border counties of States, and there does not seem to be a great deal of reason why it should not be applied at an early date, even if it is not perfectly carried out. It will be difficult to get it in a state of perfection, but just because it can not be put into a state of perfection immediately is no good reason why it should not be inaugurated on a larger scale than at present, if possible.

Dr. **Anderson.** It appears to me that if we wish to be practical we need to coerce the medical profession into reporting the communicable diseases coming to their attention. If they did this punctually, not very often would a person with a communicable disease be on travel status.

It seems to me that the chief danger lies with "carriers," and those types of infection which, because of their very mild symptoms, arouse no suspicions in the minds of the laity concerning the possibility that the slight indisposition in one individual may assume grave proportions in a susceptible contact.

I am convinced, so far as the subject relates to the State of Washington, that the profession does not regard the reporting of communicable diseases with sufficient gravity. And this applies to other vital facts in connection with health activities.

I believe that the United States Public Health Service could render valuable aid in this direction by instituting a campaign in medical schools, favoring the adoption in the several curricula, of lectures on the importance of the prompt reporting of birth and death returns, as well as communicable diseases—this both for scientific and civic reasons.

In the matter of infectious diseases, prospective doctors (medical students) should be instructed concerning the importance of reporting not only communicable diseases, but the suspicion of such diseases. To illustrate, report to the health department a child with a slight coryza and faintly injected conjunctiva as suspicious of measles. "Pass the buck," if you please, to the health officer.

We health officers might profitably visit the medical societies and urge one society to enter into friendly competition with sister organizations for approximating 100 per cent in the reporting of all necessary vital facts.

Dr. **Welch.** I was impressed by the address of Dr. Fulton, that he was not especially interested in California because of the distance. Last summer there were some visitors from the State of Washington in Alabama who contracted smallpox while there. They were immediately isolated by one of the health officers of one of the counties, and in the night time took the train back to Washington. As soon as I could ascertain the facts and get the address of the individuals I notified the health department of the State of Washington. We have the habit of following the lead of my distinguished friend from Louisiana, of notifying each other of any outbreak of the communicable diseases in border States. Whenever there has been an outbreak of a new case of bubonic plague in Louisiana, all of us in adjoining States have been notified by the health officer of Louisiana. Recently when there was a suspected case of bubonic plague in Mobile, I wired all the health officers of contiguous States. I was under the impression that we all had such an understanding and that we were all following that line of procedure.

(Moved and carried that the report on interstate quarantine regulations be accepted.)

Dr. CUMMING. The next report of the standing committee is that on rural sanitation by Dr. W. S. Rankin, of South Carolina.

Dr. RANKIN. Mr. Chairman, I have asked Dr. L. L. Lumsden to make the report.

Dr. Lumsden made the following report:

REPORT OF COMMITTEE ON RURAL SANITATION.

I have had for a long time a misconception about the duties of the chairman of a committee. Until this morning I supposed that the chairman was the one to do the work. I don't know why Dr. Rankin didn't make the report. He knows exactly what to say and can say it much better than I can. The members of this committee have reached a definite agreement about what should be the program of the members of this conference on rural sanitation. This matter has been discussed before this conference at each meeting for some years past, and I don't think it is necessary for the committee to go into any of the elementary details about the importance of rural sanitation in the United States and the need of marked advancement in this work. Recently the Public Health Service office of Rural Sanitation has sent out a questionnaire to all of the States, with a view to ascertaining the extent of whole-time health service, local health service in the rural districts of the United States. This questionnaire applied to the date January 1, 1920. There is a place on the program a little later, Mr. Chairman, for these data, but I think the data in a way will serve as a foundation for a discussion of the recommendation which this committee will make, and so with your permission I will submit them at this time.

This questionnaire was an inquiry to ascertain how many rural districts in the United States, as of January 1, 1920, were provided with whole-time local health service. The answers to this questionnaire have been received now from all of the States, so I think the data are as complete as we are able to get them. There are, according to the reports received, in the United States, 98 rural districts, composed in all instances except two or three, of counties which are provided with whole-time local health officers.

Think of it, only 98 out of some 2,800 counties wholly or largely rural in the United States are provided with whole-time county health officers. That is about 3.5 per cent. That is a sad report of progress in this field which is recognized by everyone who knows anything about the subject as of vital and urgent importance. Of the 98 counties provided with whole-time county health officers there are 22 in which the health officer serves alone; that is, he has no official assistance, no sanitary inspector, no health nurse, and no clerk. He is monarch of all he surveys in a health field with an area of about 40 or 50 miles long and about 20 or 30 miles wide and with a population of 20,000 to 50,000. All of us who know anything about public-health work know that a one-man health organization in such an area is inadequate and is suggestive of one trying to feed an elephant with a spoon. Among the 76 counties with whole-time health officers in which the health officer has assistance, the assistance consists in some instances of one sanitary inspector or one health nurse, and in a few instances of more than one sanitary inspector, or more than one health nurse. This gives a summary of the findings of the survey of the counties of all States. This is the situation so far as local health service is concerned. In the States, the State provides whole-time district health officers who look in a very general way after health conditions in the 8 or 10 or more districts into which the State is divided, but they are not included in this summary. This summary applies only to the health district which has a local health officer paid in whole or in part by the county, township, or district in which he works.

The United States Public Health Service has been endeavoring for several years to aid the State and local health departments in the advancement of rural health work. The program has been outlined in previous conferences; it is based on the principle of cooperation. The United States Public Health Service goes into partnership with the State health department and with the county, to establish and maintain a local health department which is definitely expected to carry out with a reasonable degree of adequacy the most important phases of health work indicated in the community. Our road in this direction has been rather rocky. The work began with an allotment made from the fund for the investigation of the diseases of man in 1914. In the following year a specific appropriation was made by Congress to the amount of $25,000 to try out what Congress regarded at that time as an experiment. We submitted reports to Congress. The gentlemen in Congress at that time appeared to think that the experiment was proving fairly satisfactory and they increased the appropriation for this work during the fiscal year beginning July 1, 1917, from $25,000 to $150,000. This was really encouraging. That increased appropriation was granted by Congress before war was declared. The hearings on the rural sanitation item were held before a committee on appropriations in the House having charge of the sundry civil bill. That bill was passed by the House before war was declared. Thus the increased appropriation for rural sanitation was granted on a peace-time basis. The war came and the program of work formulated was interrupted; most of the money had to be used in the areas around the national camps and in the areas around the most important war industries. The same amount, $150,000, was appropriated for the following fiscal year beginning July 1, 1918.

After the active period of the war was over we hoped to obtain at least that much money to distribute among the States for cooperative county health work. We were disappointed when Congress, after what appeared only perfunctory consideration of this vitally important matter, reduced the appropriation to $50,000 for rural sanitation in the present fiscal year beginning July 1, 1919. With this $50,000 we have strung out the work as far as it would go to what appeared the very best possible advantage. Against the $50,000 allotted to counties, 30 in number, in which we have entered into cooperation in the present fiscal year, there has been appropriated from State and local sources an amount aggregating over $225,000. The detailed results have been highly satisfactory. We thought, with that showing and with the increasing demands for our cooperation in this field, that Congress might see its way to grant an increase in the appropriation which would enable an increase in the activities. Again, however, we have been disappointed. The House Committee on Appropriations in Congress recommended only $50,000. An attempt on the floor to increase the amount to $150,000 was voted down and the bill passed the House carrying only $50,000. Thus we shall have only $50,000 to assist State and local government in cooperative rural health work in the present fiscal year.

I have gone into these details because I think from this history we must realize that there has not been put behind this request of the United States Public Health Service and of the Treasury Department for increased appropriation for rural sanitation, the popular demand which is absolutely essential to get the sort of reaction necessary to secure a reasonable increase in the appropriation. Our estimate for rural sanitation in each of the fiscal years 1920 and 1921 was $500,000 and the amount appropriated was $50,000. Now, if the work in the counties in which the cooperative plan has been carried out had met with failure I think we should be reconciled with the attitude of Congress toward this business. But in every one of these counties the success stands out strikingly, very encouragingly, and we can measure in dollars and cents the value of this work. I think we can safely conclude that this work—this cooperative county health work—has well passed the experimental stage, and the question which we must answer, which the people must answer, and must answer through their representatives in our legislative bodies, is not whether this work is worth while—everybody grants that—but whether the National Government should take part in this kind of business or not. That is the question which this conference, I think, should express an opinion about. It is the one persistently raised in Congress. Without further disastrous delay the people of this country should decide whether the National Government should take part in this business of health promotion and disease prevention or not. Congressmen apparently opposed to the work eternally ask, "Why should not the States, the counties, and the individuals do these things for themselves"? If the National Government has a right to assist communities in any line of activity it surely seems to have a right and an urgent call to assist in rural sanitation.

The Federal health agency can not conduct this work in a reasonably businesslike way if it must continue to depend each fiscal year upon a new Congress or another session of Congress determining along in June, sometimes not until July, how much money is to be available to invest in this enterprise. To have to make our contracts after the fiscal year has begun is a serious handicap. To overcome that difficulty a bill was introduced two or three years ago by Representative Lever, providing for a continuing appropriation to be allotted to States each year on a basis of population for cooperative rural health work. Until we get some comprehensive legislation of that kind this work can not, according to every element of common sense, be conducted on a satisfactorily businesslike and economic basis. Therefore the members of the committee on rural sanitation of this conference have agreed to make to this conference the definite recommendation that those participating in this conference discuss and decide upon what kind of legislation is needed and especially whether that contemplated by the so-called Lever rural health bill is of the kind needed. This cooperative rural health work is in line with the general principal of Federal aid extension which is being carried out apparently with success in several different fields of activity of the Government. It seems more logical for the Federal Government to extend aid in the prevention of the spread of communicable human disease than in any other field in which it is engaged in the application of that principle. Communicable disease control is not only of local importance, but also of State-wide and Nation-wide importance.

Now, it does little good, if the sense of this conference should be that the National Government should take part in this business, for the conference to pass a resolution to that effect and stop with that. It does but little good if one of you writes to a Congressman saying that you hope he will support the sundry civil bill when it comes up. Hearing from you as a health officer; he may say, "Oh, these fellows are always trying to do more and more," and if he hears from no one but you, you can not reasonably expect him to get off his coat and go to work to get enacted the kind of legislation requested. If we mean business in this matter we must go back to our States and start a constructive campaign to bring about the kind of sentiment which Secretary Moyle referred to as necessary to move Congress. The thing to do is to appeal to every organization which properly can function in such a matter and to every individual whom you can reach to let the Congressmen and Senators know what is the sentiment of the people in your respective States toward this proposition. Until Congressmen know that, and know it in clear-cut terms without any uncertainty, we can not expect them to enact the legislation which is absolutely essential before the Public Health Service, as a Federal health agency, can give you the assistance and cooperation which evidently is needed, which we should like to give you and which I personally think we should give you.

Dr. **Freeman.** I am very sorry that this cross section of Dr. Lumsden's was taken on the 1st day of January. As most of you know, we expected to double this 98 whole-time health officers on the 1st day of January. Unfortunately, we were not able to carry out this program. I am very glad to tell Dr. Lumsden, however, that we have added since January 1, 30 whole time county health officers to the 98 he has listed. Of these only one man is working absolutely alone. I am also very glad to report that the system is working with increasing efficiency and satisfaction. There was a very real question in the minds of many of our people whether a single man working in a county would be able to give as immediate and efficient service as the 15, 20, or 25 local health officers had been able to give. That question has been answered in the affirmative and so positively that we are having no further difficulty. The only difficulty we are encountering is to get these 30 full-time health officers to set up a constructive practicable program and carry it through.

So far as we are concerned in Ohio, I think there will be no difficulty in expanding this system until the whole State is covered. We have some very interesting variations. We have in one case two counties being served by one whole-time health officer with a separate staff in each county. We have in five cases a county health officer serving both the city and the county. That is working out very satisfactorily. They maintain two sets of employees, one supported by the city and one by the county. We have done this in Ohio without any Federal aid or any outside aid of any kind. But like all missionary enterprises, we take money where we can get it, and I think we could use Federal money to good advantage. I think all of us appreciate fully that the future of health work in this country depends upon the establishment of whole-time service in the rural districts.

You can look at it from any angle you please, but any man who studies this subject must come to the conclusion that we will never have a national health program worthy of the name until we have a universal system of full-time health service. In some States, as in the Northern and Eastern States, the economic resources of the States and counties are adequate to support such a system without outside aid. There are, however, in large parts of the country counties and States which are unable economically at this time of high cost of gasoline, automobiles, victrolas, pianos, and other necessities of life, to support luxuries like full-time health officers. The logical source of aid is the Federal Government. I believe with all my heart in the use of every legitimate available means to forward this thing. Some of us may have our own ideas about State and Federal rights, but I do not let that stand in the way of a chance to get a full-time health officer. I think this conference, if it is really in earnest about the promotion of the public health, must support a proposal whereby we can do for health what the Federal Government is doing for roads this year. If 10 per cent of what is spent for roads could be applied for health on the same system of Federal aid, we would within five years have a universal system of full-time health service. It is a question of expediency and a question of earnestness of purpose, and I for one want to back Dr. Lumsden, as I have been in the habit of doing for the last 10 years, and add a very hearty amen to everything he has said.

Dr. **Harris**. The question of rural health administration is one which vitally affects everybody interested in public health, and, especially, every health officer, whether he represent a city or a rural community. It is assumed that we are all agreed as to the essential value of rural sanitation, and we will therefore not argue as to the details of the program suggested by Dr. Lumsden, but direct our thoughts to the significance of his statement that our legislators are against increasing the Federal and State appropriation for rural sanitation. Since we agree as to the colossal importance of public health work in rural sanitation, it becomes merely a question of what methods we shall pursue to realize our aims in this field. You can not bring about action that will be valuable and serviceable unless you have a rallying cry that will strike a sentimental chord. During the war, you know, our health propaganda was aided tremendously by the fact that we brought home to the public, and to our legislators as well, that it was necessary to conserve the welfare of every individual in this country, so that our conduct of the war would be successful and efficient.

It was upon the basis of efficiency and the necessity of meeting a national crisis that we made a forceful and successful appeal, and to a considerable degree won the support of many for our health program. At this time, when everyone is stressing the need of increased production, and when those in authority are predicting that famine threatens the country, because production on the farm is limited, it is appropriate and necessary to bring home to people at large, to the business world, and to legislators, that limited production is due in no small measure to the wastage of energy and life upon the farm which is traceable to preventable diseases, and that the loss of human power which these diseases cause results largely from the fact that our rural sections show an appalling poverty of resources for protecting the health and lives of those on the farms. Where even partial provision is made to guard the health of the rural population, those officers, upon whom the welfare of the residents on farms in every community depends, are not capable of doing their work, principally because they lack the necessary funds and assistance. It is timely to impress the importance, and to bring home the necessity, of conservation of man power on the farm and to make that need felt as the paramount one by associating the present deficiencies in production with the struggle to protect man power from the effects of diseases caused by poor rural sanitation. We must tie up closely the necessities of the moment as they come home to everybody through the effects of the high cost of living, wherever they may live, and so capitalize the present lack of food products and of farm help, and focus the light of publicity upon these facts for the attention of those who have never thought how important it is that those living in rural communities should be healthy, if only that they might more efficiently supply the demand of cities and of towns the world over for adequate food. We must bring it home to legislators that the unsatisfied demands of the farmers for help upon the farm to answer the call of the cities for food can be met successfully by preserving intact the energies of those already on the farm, so that their numbers may not be depleted by preventable diseases which now claim thousands of victims among the rural population.

We can gain a great victory for rural sanitation, not merely by passing resolutions, but by a forceful scientific expression of opinion coming from this board of public health officers, concerning the welfare of the people of the country, and its relation to the welfare of the rest of the world whom they serve; and we can gain support by arousing the newspapers of the country to take note of the situation, and see the necessity of adequate health appropriations to conserve the welfare of the rural population, as a direct help in meeting the needs of the country as a whole.

We lay too much stress upon communicable diseases, failing to realize that, important as they are, emotion and sentiment can not very effectively be developed or crystallized on that subject. The thing we feel of transcendent importance at the moment is the need to assure the people, living in cities or in rural communities, that production must and can be maintained only by a liberal policy toward rural sanitation, in the same manner as we stressed the relation of health to the welfare of our country and its Allies during the war. And so I would urge that there be an aggressive and emphatic expression of opinion coming from this body of health officers, representing all shades of thought and all parts of the country, calling attention of the country at large to the fact that in this moment of national necessity there is at least one means of helping out, by greater attention to rural sanitation and by large appropriations for rural health administration. And for the purpose we must arouse and secure the support of our newspapers throughout every part of the land. Let us not forget newspaper publicity on this subject in order that our expression of opinion may become vocal and make itself heard even in the chambers of our National and State legislatures. If adequate appropriations for preventing the untimely death or unnecessary sufferings of thousands of our rural population can not be secured by an appeal to humane sentiments, then let the appeal come through the economic motive.

Dr. HURTY. There is one energy or force which we may use in advancing the public health cause which must not be forgotten; that is the force or energy of the business men. Make the business men understand the importance of all public health causes by bringing forcibly before them the facts pertaining to health and business and a force will be enlisted which will be irresistible. Very nearly all we have been able to secure in Indiana in the public health line has come through the business men, not by appealing to their avarice, but instead by appealing to their sentimental and emotional nature. We did not realize for 10 or 15 years that we must appeal to sentiment, just as the former speaker has contended; otherwise we are liable to fail. We, and I mean by "we" the Indiana State board of health, secured the support of every individual Congressman for the Lever bill, unless perchance they went back on their promises, which might have happened with one or two. We first appealed to the business men's organizations at home and sent their resolutions to the Congressmen. We also appealed to many farmers' institutes and sent their resolutions to our Congressmen. These told the Congressmen how to vote if the Lever bill came up. We insisted the Lever bill was a business proposition and, furthermore, it had a bearing upon the higher qualities of the mind and would be uplifting and add to our enjoyment of life if it were passed. We know that a large proportion of the insane women in every State come from the farm, and this fact was used in arousing sentiments and emotions of business men so as to direct their attention and finally their energies toward the passage of the Lever bill. We told them it is disease that brings insanity; it is disease that brings quite all of our miseries and sorrows and causes us to fail. We asked all the business organizations we addressed, when urging them to support the Lever bill, "Do you wish to stop the flow of insane women from the farm into the insane asylums? Do you wish to see farmers more efficient and happy? If you do, then you will support the Lever bill and will further do all you can to raise the health on the farm."

The business men's organization at Indianapolis appointed a committee to see that our Congressmen and Senators were informed that the Lever bill was good business, and further, that it was more than good business. It would make people on the farm not only richer but also happier. The Indiana Legislature promptly made an appropriation which would equal that appropriated by the National Government, and it stands now upon the statute books ready to be used if ever the Congress takes action. Indianapolis is in the seventh congressional district, and our Congressman, Hon. Merrill Moores, was so impressed with the arguments for the Lever bill that he worked for it as well as voted for it. When at home one time he called at my office and expressed his interest in the cause of the public health and positively stated that he would work for every reasonable health bill that ever came before Congress while he was a Member. Mr. Moores was renominated and I hope he will be elected. In our conversation he stated that he would work for the bill and support it despite the fact that a budget of $5,000,000,000 was placed before Congress. He said: "I do not know how we can raise this vast sum, and a great deal of it is unnecessary, but rural sanitation must be attended to." Continuing, he said, "The budget will be cut down where the Congressmen least understand. I shall try to make them understand, so far as I can, that it will not be economy to cut the budget when it comes to the Lever bill." We have some money which can be used for rural sanitation, and would have had a goodly sum had the Lever bill passed.

May I tell you briefly what we are doing for rural sanitation at this time. Our Divisions of Tuberculosis and Child Hygiene are mounted on wheels. I mean that each division is provided with an automobile truck and touring car, which is fully equipped with exhibits, moving-picture machine, stereopticon slides, moving pictures, illustrated exhibits, and all things necessary to make their work a success. These traveling divisions give all their time to the extreme or back rural districts, those districts which have had little or no attention paid to them up to this time in the line of public health instruction. The tuberculosis outfit carries an entertainer, who sings, tells stories, makes recitations. Music is further supplied by a good victrola. The automobile trucks are provided with Delco dynamos, and thus always have an electric current for their moving pictures, for lighting schoolhouses and churches, and other places where exhibits may be held. The localities to be visited are notified beforehand, and the rural part of each township is well stirred by the work done. Imagine one of these divisions, with flags flying from the automobiles, entering a town and blowing a trumpet and announcing its coming. The meetings always have big crowds, and in almost every instance a schoolhouse or church will not hold the audience. When the weather is good the meetings are held out of doors, the curtain to receive the pictures is put against the side of a house, the lawn in front being used for the audience.

Our Tuberculosis Division lays emphasis upon the fact that 80 per cent of consumption is contracted in childhood. The matter of giving milk and proper food to children is thoroughly emphasized, also the importance of fresh air, cleanliness, and cheerful surroundings. We feel we are getting excellent results, and many letters are written by the rural dwellers commending this work. Our pamphlets are distributed only to those who ask for them. The speakers tell their listeners the pamphlets are on hand and will be given only upon request, but will not be generally distributed. We feel that by pursuing this course more good is done than if general distribution, with its attendant very considerable expense, were adopted. Again, I wish to say, in your public health work, and when you wish to secure an appropriation, don't forget to secure the influence of the business men. Make it plain to them that the business of the public health is the most important business that is before the business men. They will quickly grasp the fact that there is economy in the public health, that there is efficiency, and also that there is happiness. It is to the business man's self-interest to see better health on the farm, and it also appeals to his sentimental and moral nature.

Dr. McCormack. I will either have to make a speech here now or a explanation to the health officers when I get back home. Whenever Dr. Lumsden has made a talk on rural sanitation we always wish to express our commendation of it. I want to tell you one other thing to add to Dr. Harris's and Dr. Hurty's remarks. They state we have to lay facts before the people of the country and Congress if we want their support. Now we have in the country our rural health department which we are all agreed must be well kept and where correct statistics have been kept; we have enough facts to convince any business man, or even any Congressman who is not a business man, of the business advantage to be derived from health work. In Mason County, with the cooperation of the Federal Government, for the past four or five years we have conducted a full-time health department. We are able to demonstrate from the statistics of this department, published from year to year, the cost of preventable diseases. We have found that the number of unnecessary premature deaths has been reduced from something over a million to something less than 200,000 per year at a total investment of less than $12,500 per year. Now that is good business, and that is the sort of statement we need to present to Congress, with the exact facts explained. This, in spite of the fact that we have gone through two epidemics of influenza, and in spite of the fact that the physical conditions of the city of Maysville have prevented the improvement of the water supply, which has caused continued epidemics of typhoid fever. Over 60 per cent of the houses have sanitary privies and are using them, and the sanitary inspector sees every one of those sanitary privies in operation at least once every three months. They were building 30 new privies last week. The people of the county are furnishing every particle of the material of which they are made, every particle of the work, building them themselves, and doing this because they found it worth while. The health work in Mason County has demonstrated not only what they can do, but shows definitely what we have failed to do, and I believe such a showing will get money from any appropriating body. In Kentucky, from the facts gathered and set before the legislature, they got an appropriation of $325,000 for the county health department. As soon as we get Federal aid (and God speed the day when Federal aid may come) we will get better health departments, bigger ones, and run on better standards. It is a pleasure to commend the United States Public Health Service here and now for the splendid health work they have helped us to do in Kentucky.

Dr. Nicoll. I feel very much encouraged by Dr. Harris's remarks. I do not know that you understand the significance of them. Dr. Harris is not under the jurisdiction of the State health department. I do not suppose Dr. Harris would know a farmer if he saw one, and yet to us, who have had more to do with rural districts, it is encouraging when a representative of the New York City health department realizes that New York is interested in a rural health problem. I do not know how much sentiment there is about this. Dr. Hurty stated yesterday that man's impelling motives were based on love and hunger. I wonder if the latter isn't the impelling motive which drives the city of New York to take interest in this matter rather than love? However, it does not make any difference what the motive is. I think when the city begins to take an interest in these matters we shall get a great deal further in the problem, as Dr. Harris has said.

Dr. Ferrell. Encouragement of rural sanitation is a task which makes a strong appeal to the International Health Board. At the present time the major part of the financial aid which this board is giving to legally constituted health organizations in the United States is dedicated to the work of developing and extending county health programs. During the past year our organization somewhat enlarged the amount of its appropriation for cooperative county health work, because prospects were hopeful that some measure, such as the Lever bill, would make possible the joint cooperation of Federal, State, and county Governments in a county health program operated entirely with public funds. Since only 3 per cent of the counties of the country, however, have as yet seen the benefits of rural sanitary work, it would seem that a great deal of further demonstration in this work is required if its influence and importance is to be appreciated to a degree sufficient to secure the funds necessary for extensive rural programs. Where county work has been done it is gratifying to find how generous the State legislatures have been and how readily the county authorities will provide creditable appropriations. Ofttimes the county funds range from $3,000 to $5,000 or $6,000 a year. I believe that this work will be the means of making rural public health work in this country what it ought to be and of unifying all branches of government, Federal, State, and local, in an enterprise which will yield definite, tangible results and win greater confidence and greater appropriations for the work.

Dr. **Carey.** I do not want this discussion to close without placing Massachusetts on record as favoring this movement, heart and soul. I believe our political and geographical status is such that we will not be benefited very much, but that will not prevent us from favoring any measure that will be of benefit and available to other States.

Dr. **Goddard.** I do not want this question to pass without placing Texas on record as favoring the movement. We have this year, since January 1, established five county departments of health. The work is just getting under way and we are entirely pleased, and so are the people, with the movement.

Dr. **Schereschewsky.** I do not think we ought to close the discussion without having it firmly in mind that any Federal measures regarding the rural sanitation are not local measures but measures which are essentially destined to further the prosperity and happiness of the entire United States. I do not think Massachusetts nor any other State, no matter how industrial it is, can deny the fact that if it does not produce food it is dependent upon other States for its food supply and must sell its manufactures to the rural States. Consequently, this matter of rural sanitation is one which affects the whole country. We are faced with an acute food shortage, as you know, and few of us realize the enormous losses in rural sections from lack of health conditions. Take the problem of malaria alone, which causes an annual economic loss of not less than $1,000,000,000. If we should succeed in eliminating malaria alone it would add, I am certain, at least 30 per cent to the agricultural produce of those States where it now prevails.

Dr. **Hayne.** I am not making that same dramatic entrance made by that health car in Indiana. This seems to have developed more or less into an experience meeting and a statement from each State as to what it is doing. Far be it from me not to allow South Carolina to have representation in this meeting as to what we are doing. We have whole-time health officers, very few of them—a little more than 3 per cent, though, of the counties are represented in the State, so we are holding our own in that respect. We do not believe in county health officers feeding the elephant with a spoon, therefore we have not provided any spoons, but use a bottle. There are seven counties in the State that have miniature county health departments, and that is the only way in which you are going to succeed in doing anything toward elevating the health standards of the county. The Angel Gabriel might come down and blow his horn in some of the counties in South Carolina and blow that horn riding in a tin Lizzie and he would have no effect in raising the health standard of that county; but if you have a whole-time health officer, an educated man who knows what he is talking about, is not too optimistic, is reasonably truthful for a health officer, does not more than quadruple statistics when presented, then you may have what they have in Kentucky—a sanitary closet, four of them, for each inhabitant of the State of Kentucky. We have been listening to reports from Kentucky for seven years; each year we have known that every inhabitant was provided with four sanitary closets. The modesty of Kentucky inhabitants is such and these closets are so well concealed that you may travel over Kentucky without perceiving one. Getting old as I am, I am getting more or less pessimistic. Pessimism depends a great deal on the—oh, well, I won't go into particulars, but there are some facts, outstanding facts, that must confront any one who talks about rural sanitation. One is its enormous cost. If you take my little State as properly presenting as cheap a form as you can get, it costs or would cost $1,000,000 annually to put on in each county of the State a full-time county health organization.

My State has about sixteen hundred thousand or seventeen hundred thousand inhabitants and bearing a very small proportion to the population of the United States, so that the cost of rural sanitation properly carried out in the United States will run into figures that would be even appalling to a Democratic Congressman, and I believe from a Republican standpoint that the Democratic Congress is responsible for all the evils both in this world and in Mars. If, however, we can get sufficient aid from the Federal Government to put on demonstrations in certain counties that will really demonstrate, so that the people rise up and demand funds from the legislature, having seen those demonstrations that one county requests, then we will accomplish something. So far as the voice of the people in asking for these things is concerned, it is so faint and so far away that we have to present the requests with a megaphone, the megaphone usually being the State health officer. If Dr. Hurty is right in his statement, in gathering statistics in regard to the amount of money that is saved by keeping people from dying, we would have to exclude all the morons, all the feeble-minded, all the vicious that are saved, because health work saves them as well as others and we could count as gained only those saved that we thought were worth while in the community. You remember the experts of the Army after carefully studying the mental caliber of the men assembled in the Army decided that physicians and teamsters had exactly or about relatively the same amount of mental development, so it may seem to the people that we had better not save all of the physicians. This is merely persiflage, but I want to get the point. I am also an uplifter and the sign manual of the uplifter is to use the expression "economic importance" and the gesture "I leave with you this one thought." If you do that you are a successful uplifter, otherwise not. I wish to leave with you this one thought: It costs money to have public health, and it takes a first-class liar to present statistics to Congress so that they will be received.

Dr. McCormack. I should like to suggest that an assistant surgeon general in the department of lying should be added to this bureau, and I would like to recommend that Dr. Hayne be nominated for the position.

Surg. Gen. Cumming. Up to the time I heard Dr. Hayne make that last remark I was going to say that we were going after this thing and would get it in the next session of Congress, but I hesitate to say that unless we call on some of our friends here present to help us. Just about a day or so after I got here I began to snoop around to see where we stood on the appropriation question. I soon found as far as I could tell, there was absolutely no chance of raising the limit on the rural sanitation problems this year, but I think we have very excellent reasons for thinking that the next session of Congress we are going to be able to do something along that line and that we are going to have very material support in the present administration in doing so. Secretary Houston is vitally interested in this subject and we are lucky in having him in charge of the department. In spite of what Dr. Hayne said, this question of getting definite data is going to affect committees of Congress the next session. We know the personality of the members. They are going to do something for us. You have got to help us out, and do that by getting definite data about definite counties. Dr. Lumsden will help you do it. By getting definite data and definite statements in definite counties, then I think we are going to get appropriations from Congresss.

Dr. Flannagan. Many of you want a case in point to refer your Congressman to and you want to get some one here near Washington. I refer you to the work Dr. Cox has done in Arlington County and Fairfax County, across the river where you can see the work being successfully done.

Dr. Lumsden. I would just like to say that the committee will submit a resolution for consideration by the conference.

Dr. Cumming. The next committee report is that of the committee on trachoma, by Dr. John McMullen. I just had a wire from Dr. McMullen that he will be delayed until to-morrow, so we will hear the progress report of the board appointed by the Surgeon General to study the problem of sanitary disposal of human excreta in unsewered communities, by Prof. C. W. Stiles.

SECOND INFORMAL REPORT TO STATE HEALTH OFFICERS.

(Prof. C. W. Stiles submitted the following report:)

During the past year the board on excreta disposal has continued work along various lines and, as was to be expected, has been more analytical or destructive than synthetical or constructive. A subject which has been studied for so many centuries with so little real progress is so complex in nature that constructive progress is slow.

Administration versus installation.—As studies of existing local conditions progress, the conviction becomes more firmly founded that administration of privy sanitation has not kept pace with installation, or to express it in other words, that it is easier to induce the public to build privies than it is to induce municipal administrators to see that they are properly cared for after they are built. The public responds well to an appeal, but local authorities do not always carry out their part of the work, hence many campaigns have not returned to the citizens a lasting health protection commensurate with the money expended.

For many years the conception prevailed that a privy concerned only the householder, and it took long and tedious labor to induce people to surrender part of their rights over this structure to the public good. Experience now shows that in many instances public officials have not properly administered the privy trust placed in their hands and that installations have deteriorated because of lack of a privy conscience in certain public officials. At least part of this condition is undoubtedly due to changes in local municipal administration due to the game of local politics and to changes in personnel of local health offices due to financial and to political conditions.

The tendency is to demand a privy which requires no supervision, but this desire will never be realized, and we had better face the fact promptly that privy administration is as important as privy construction. No type of privy will give satisfaction unless it is given proper attention, and in this connection I would invite your attention especially to the subject of the—

Necessity for better supervision over scavenging.—Privy sanitation is a cooperative affair. The public is called upon to cooperate by paying out money to provide the privy and to obtain proper scavenging. The health officer is paid by his clients, namely the public, to cooperate by telling what kind of a privy is acceptable, by inspecting in order to determine the frequency of necessary scavenging, and to cite his employers and clients to court in case they do not provide a prescribed privy. The scavenger is paid to scavenge and to dispose of the contents.

Extensive campaigns are carried on at public expense to instruct the householders as to their duties; but I would suggest that there is not adequate provision for giving to the public the tangible proofs that either the health officers or the scavengers are giving proper service in return for the money paid by the public.

The average scavenger I have seen turns the city with a pail system into a city-wide, open privy by scattering and spilling the can material along the streets from one end to the other, and many local health officers exhibit less enthusiasm in stopping this nuisance than they do in threatening to prosecute householders for not complying with privy construction regulations.

The question arises as to who is responsible and how the condition can be bettered.

Primarily it is, of course, the scavenger who commits the nuisance, and with the night-collecting system the nuisance will continue to a greater or less degree, for as long as given local regulations prescribe that the scavenger will be fined in case he does this work during hours when he can see to do it properly, he will continue to do it improperly.

The next responsible persons are the inspectors. Many men of this calling are, in my experience, unfitted for their job, have little or no interest in it, too frequently make up their reports at home, by routine, instead of actually inspecting privies and reporting upon actual instead of theoretical findings, and too frequently they are purely political appointees. If you reply that you know inspectors of a higher type, the answer is that I also know good inspectors and that the foregoing criticism applies to the average, not to the superaverage inspector.

Highest in responsibility comes the health officer who too often leaves matters to the inspectors and does not take a first-hand interest in what is going on in the back yards. In other words, he is not sufficiently active in his supervision.

Dr. Rankin's North Carolina law seems to be the best of any of the State laws we now have on the privy problem. Still, this excellent law is from one point of view incomplete, namely, it penalizes the householder for not carrying out properly his portion of the cooperative arrangement, but it does not penalize the scavenger, the local health officer, or the town for not carrying out their part of the contract. I have personally seen privies even in North Carolina which had been built in good faith by the people, and at considerable expense, but which were in an outrageous condition due to poor scavenging, poor local inspection, and poor health-office administration.

The point I want to emphasize is that proper administration is a sine qua non in proper privy sanitation and that the administrative authorities are not held sufficiently to account for lack of efficiency in their part of the contract.

To suggest a practical remedy for this evil is more difficult than to define the fault; still the effort should be made. The remedy I would suggest may perhaps be considered slightly radical, but if you have a working suggestion that is less objectionable, I hope you will bring it forward. I would apply to the city or town which is derelict in its duty in sanitation the same principle that is applied to the individual, namely, publicity by the State board of health. Why should the owner of property be publicly published to his neighbors and fined if his children do not use the privy properly, when the town authorities are permitted, without a supervising public rebuke, to pollute the highways? The public health principle involved in the nuisance is the same, and the only essential difference is that the citizen has to pay out money in order to accomplish his side of the cooperation, while the city and its employees are paid for their part of the cooperative work.

We constantly harp on the necessity of educating the public in sanitary matters, and we even have recourse to the courts in order to enforce compulsory education along these lines. My suggestion is that more State boards of health inspect local boards of health and apply the same education and publicity to these which the local health officers apply to the citizens. Why should State boards publish comparative morbidity and mortality statistics but remain quiet upon the comparative status of the causes which underlie these figures?

Disposal of excreta.—In some of the privy campaigns, the important point that the privy is only a temporary storage place for excreta has not been sufficiently emphasized, and it has seemingly been assumed that this represents its final resting place also. Strange as the proposition may appear, privies have actually been installed without any definite plans as to future necessary scavenging and disposal. This is a distinct shortsightedness in administration in connection with a basic necessity of sanitation and the fault lies clearly at the door of local health organizations. What good does it do to arouse enthusiasm among the public to install privies if the people are to become disgusted with them later because there is no arrangement to clean them?

We must frankly admit that the cleaning and disposal problems are complex, but that is no valid excuse for avoiding the subject until it becomes critical.

The disposal of excreta involves administrative and technical problems in finance, labor, water pollution, soil pollution, bacteria, protozoa, and insects (especially flies). No one method is conceivable which can possibly cover all of these points for all localities. The disposal problem, like the question of privy types, is so intimately bound up with local questions that it requires a practical exercise of judgment in order to determine what should be done, and unless certain local governments exhibit more interest in their local disposal problem, privy sanitation will remain insanitation. As an example, the health officers of two cities in a certain State have recently informed me that they did not know what was being done with the night soil.

The chemical disinfection of excreta in bulk, after it is collected, is a laboratory possibility, but it is too expensive for practical use. Last year I reported most encouraging results in bulk disinfection with as low as three-quarters of 1 per cent caustic soda; subsequent studies on other samples of excreta fail to give uniformly satisfactory results with this low percentage. In summer work on certain samples in bulk we had excellent results with sodium dichromate, but winter work with other types of night-soil was less favorable. Present knowledge of the subject and present prices of chemicals and labor do not combine to give a satisfactory method of chemical disinfection of large quantities of excreta and this plan can at present best be tabled as a financial impracticable proposition until there is a fall in prices or until the happy finding of some very cheap satisfactory chemical. This does not mean that the chemical privy is of necessity impracticable. On the contrary this type has its distinct uses among people who will take proper care of it.

The drying of excreta by a rotary drier is entirely possible from a laboratory point of view, but this method also is economically impracticable as a working proposition under present conditions, since the purchase, installation, and working of the apparatus involve problems in finance, fuel, power, and labor that are beyond the funds available for this purpose in the average town.

Experiments in disinfecting with waste steam were planned but not undertaken. The problem of ordor by this method is an important one. We hope to try out this method next year.

The incineration of excreta seems at present to have a very limited field of practical application. There is some promise in this method when local conditions are favorable so that waste fuel can be utilized.

Thus, given present conditions of finance and labor, when the question of "How much will it cost?" is of necessity the great final standard by which methods must be judged, we are forced to the conclusion that the disposal into sewers or into septic tanks, and burial by one technique or another are the methods which come into practical consideration.

In studying the question of burial of excreta we are forced to consider the problems of expense, of labor, of pollution, and of flies. The expense, labor, and pollution problems have led the board to consider the possibility of eliminating the trench and of utilizing the bacterial action of the top soil by dumping the excreta on the surface and covering it with sawdust. This method seems to have certain advantages and certain disadvantages, and it is limited to the practical availability of sawdust.

As shown by the photographs (figs. 1 to 5), a rim of sawdust can easily be made inside a movable frame work and a layer of 1 to 6 inches is placed on the ground. The scavenge wagon dumps into this sawdust box and the fresh night soil is easily covered with a layer of 4 to 6 inches of sawdust. The odor is almost negligible, for after the excreta are covered, the odor is not detected 6 feet a way.

Experimentally, if water is poured into a jute bag which has been filled with sawdust, some of the fluid is retained, but much of it runs through and drips out at the bottom within a few minutes. The same process obtains in our sawdust boxes, namely, some of the fluid is retained by the sawdust, but much of it sinks promptly to the top soil layer and thus comes into contact with the soil bacteria, and this gives a sanitary advantage over the burial of excreta in a trench, for by this sawdust method the ground water has the added protection of the top soil. The rapidity with which the fluids and the contained bacteria reach the ground water will of course depend upon several factors, namely, the amount of original fluid, the amount of rainfall, the permeability

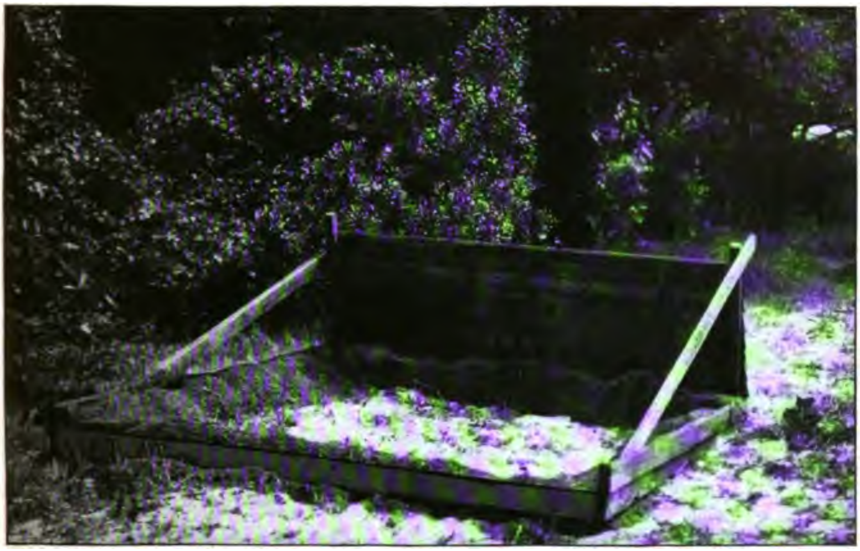

FIG. 1.—FRAMEWORK FOR SAWDUST-COMPOST DISPOSAL.

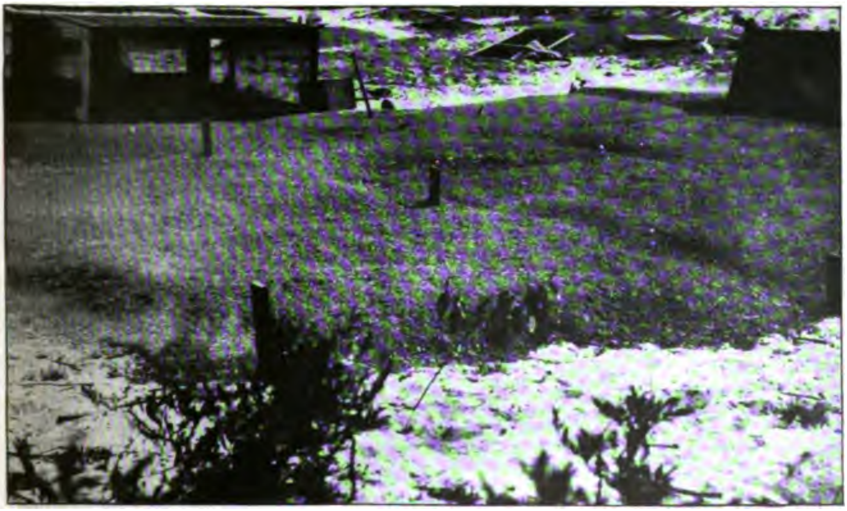

FIG. 2.—SAWDUST-COMPOST PILES.

Each square represents about one cubic yard of can material. Notice the birds catching the flies which issue; frequently 20 to 100 birds are found on the piles.

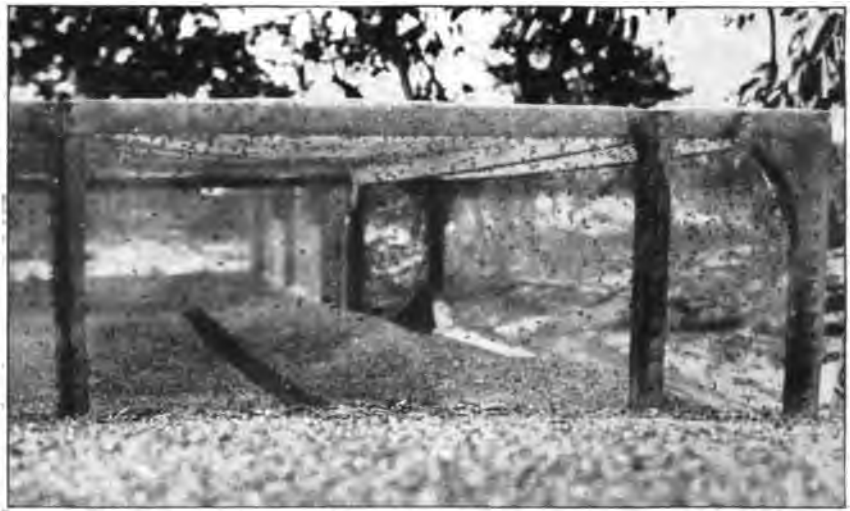

FIG. 3.—TWO SAWDUST-COMPOST PILES, SCREENED TO DEMONSTRATE THE NUMEROUS FLIES WHICH ISSUE FROM NIGHT-SOIL COLLECTIONS.

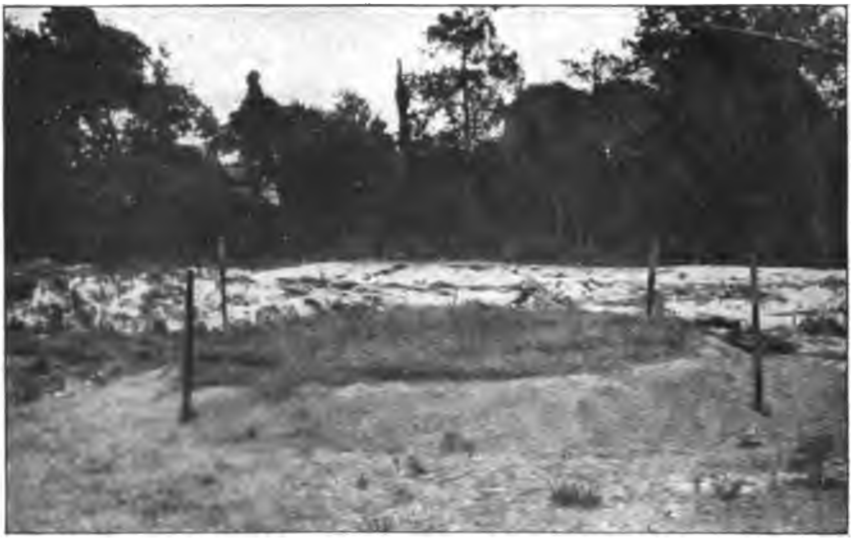

FIG. 4.—A SAWDUST-COMPOST PILE, SHOWING GROWTH OF GRASS. THIS GRASS "BURNS OUT" AFTER A FEW WEEKS.

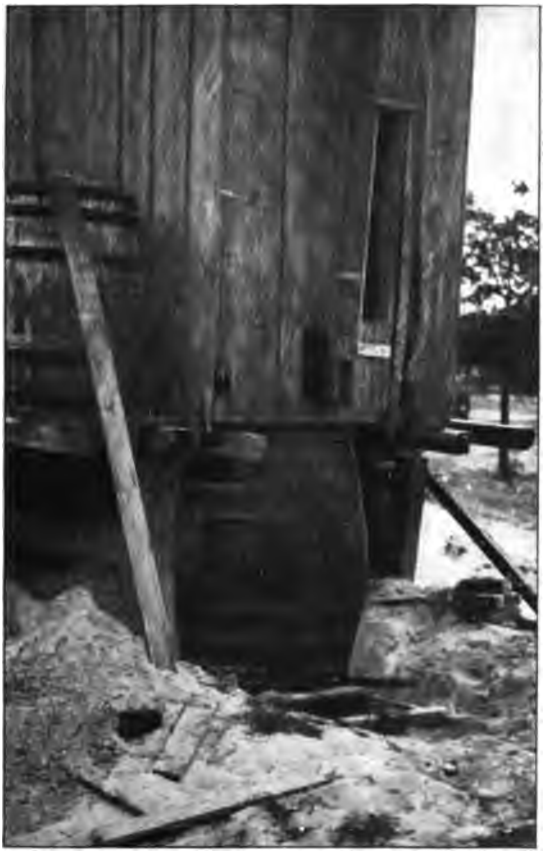

FIG. 5.—THE ORIGINAL EXPERIMENTAL BARREL SAWDUST PRIVY AT THE MARINE HOSPITAL RESERVATION, WILMINGTON, N. C.

It is located on a slope at the end of a platform which may be taken to illustrate the possibility of locating a privy on a porch or "gallery." The old superstructure is the privy-house of the original out-of-door L. R. S. experimental privy; the first experimental L. R. S. was an indoor unit.

of the soil, the level of the ground water below the surface, and the great factor of time. Our experiments have not yet extended over sufficient time to permit consideration of all of these sides of the problem, but it is obvious that surface sawdust-composting is safer than trench burial.

The odor from the sawdust-compost piles is sufficient to attract flies for a few days, and if the sawdust layer does not cover the excreta completely the insects oviposit, the fly larvæ burrow into the excreta, feed, and pupate. Naturally the excretal mass is fly-blown at the time it is collected, and the eggs and the larvæ continue their development (fig. 3). Accordingly, the fly problem is not eliminated, and up to date no economically practical method has been developed to destroy this fly infection. Birds, especially sparrows, are promptly attracted to the piles and devour thousands of flies as they issue and before their wings are sufficiently hardened to permit them to escape. Numerous flies can be captured in traps. But the fact remains that sawdust compost only partially solves the fly problem, which, however, does not seem any greater in this method than in trenching.

In connection with the bird cooperation in the disposal of excreta, a very practical point develops. The field selected for burial is very frequently one which is devoid of trees and bushes. It is, however, a well-known fact that birds are attracted more to wooded than to nonwooded fields and on this account I would suggest the advisability of selecting, whenever feasible, a field provided with or surrounded by trees and bushes. We have found that our trees and shrubs (fig. 1) at the Marine Hospital, in Wilmington, are of distinctly practical value from a standpoint of bird cooperation, for if the birds, while feeding on the flies, are disturbed by cats, dogs, or other factors, the trees and bushes give them near-by refuge and protection, and they return promptly to the sawdust piles when the danger is passed. If they had to fly a long distance, their return would doubtless be less prompt.

Hookworm eggs develop in sawdust if sufficient moisture is present, but this side of the problem does not worry me, for as the piles become dry from action of the wind and sun, many of the young hookworms will be killed by drying; others will sink into the soil and if left undisturbed a sufficient length of time will certainly die of starvation.

Thus, composting with sawdust seems to present an additional method of night-soil disposal which will be applicable in some localities. It saves the cost of digging trenches; it gives a somewhat better protection against pollution of the ground water; it is not offensive from the standpoint of odor; theoretically, at least, it utilizes the manurial value of the excreta to a considerable degree; it does not completely solve the fly problem (but what method does or can?); and its practical application depends upon the immediate availability of sawdust without prohibitive expense for hauling, hence the method is to be considered only as applied to sawdust localities.

Types of privies.—The longer I study the privy problems, the less relative importance I am able to attach to the question of the various types, as a fundamental problem, and the more persuaded I am that there is and can be no type which can be accepted as the "universal privy." The type to be selected is dependent upon local conditions of finance, mentality, soil, and labor, with the thought that we can not actually recommend a privy which involves a compromise with our conscience and responsibility. For instance, the chemical privy has its distinct uses, but from practical considerations I would certainly not recommend it for installation in a "buffer" cotton-mill village. The LRS system is excellent, but I would not recommend it if the drain pipe is to be laid directly in soil instead of in a bed of cinders or other proper material. The can system has its proper use, but it must be predicated upon a proper scavenging system. The pit has its proper field, but this is not in limestone or high ground-water regions. The only type which I am willing to condemn as almost totally vicious is the "surface privy open in back" ("type E"), and it is to this atavistic type that all other types sooner or later revert unless there is proper privy administration; still, even this "type E," so called, can be improved and used to advantage under certain exceptional conditions.

In acknowledging the premise that the type to be selected is a local, and often even an individual problem, I invite your attention to what appears to be a new type which we have recently developed and which has been satisfactory to date in actual use during the experimental study. This is not presented as a "universal privy," for it is of necessity restricted to local conditions; but in certain areas it will seemingly be an improvement over the pit, the can, and the vault, and it is so economical is construction and upkeep that it should be adopted by certain families more readily than is either the LRS or the chemical system. You notice that I said it *appears* to be a new type. It is in fact new to the board, but we can hardly guarantee that anything is absolutely new in privy building. As a descriptive name, I suggest the barrel-sawdust privy.

A barrel-sawdust privy.—Variations in styles and construction of privies are nearly as numerous as the articles upon these outhouses. To a person who seeks a "universal privy," no excuse exists for multiplying either styles or details of construction. But to the person who recognizes the point that the idea of a "universal privy" is only a bubble, a multiplicity of variations in styles, types, and details, is a desideratum.

Every simplification in construction and every suggestion for the utilization of materials already on hand are to be encouraged, since the ultimate object is the safe (or the safe-as-feasible) disposal of excreta.

Among the conditions under which sanitation is poorest may be mentioned farms, sawmills, construction camps, and chain-gang camps. The privy suggested in the present report is especially adapted to sawmills and to construction or to chain-gang camps in the vicinity of sawmills. Its use on farms, as a substitute for the pit privy, is dependent upon the size of the family and the availability of sawdust barrels, and hogsheads.

Construction.—Place a water-tight hogshead (figs. 5 and 6) (as a molasses hogshead) on skids; knock out the head, but preserve the bottom; nail four braces on the outside of a water-tight barrel (as a turpentine barrel), about 17 inches from the top; knock out both head and bottom; set the barrel into the hogshead, resting it on the braces; fill the hogshead with sawdust up to the lower end of the barrel (or a little above this line); place sawdust in the entire space between the top portion of the hogshead and the outside of the lower portion of the barrel (to keep out flies); use the barrel as the "riser" for the seat, and place on top of the barrel a seat with falling lid. The privy is now fly-tight in construction. It can be located at the end of a platform, such as a porch, or inside an outbuilding, and its location determines whether or not steps must be built to permit its use.

Use.—There is more or less separation automatically of the fluids and solids, since the urine sinks promptly into the sawdust while the solids accumulate on top.

Cleaning.—When the fluids and solids accumulate to an extent that calls for emptying, the barrel is lifted out; the fluids and solids are now left in the hogshead, but some scraping is, of course, necessary to clean the solids from the inside of the barrel; cover the excreta with the surplus sawdust between the barrel and the hogshead; hitch a mule or a horse to the skid, draw the hogshead away to a distance of say 200 to 1,000 feet away from the original location, turn it over, thus dumping the contents on the top of the ground (fig. 7) and, if necessary, cover the pile with about three inches of sawdust. Our observation is that additional sawdust will not always be necessary, though it is advisable. If the contents have been fly-blown, because of failure to close the lid, the flies will, of course, develop and escape through the sawdust cover, but this latter will prevent or at least vastly decrease new fly breeding and the odor from the sawdust pile is nil or practically nil. This pile should be left undisturbed for a

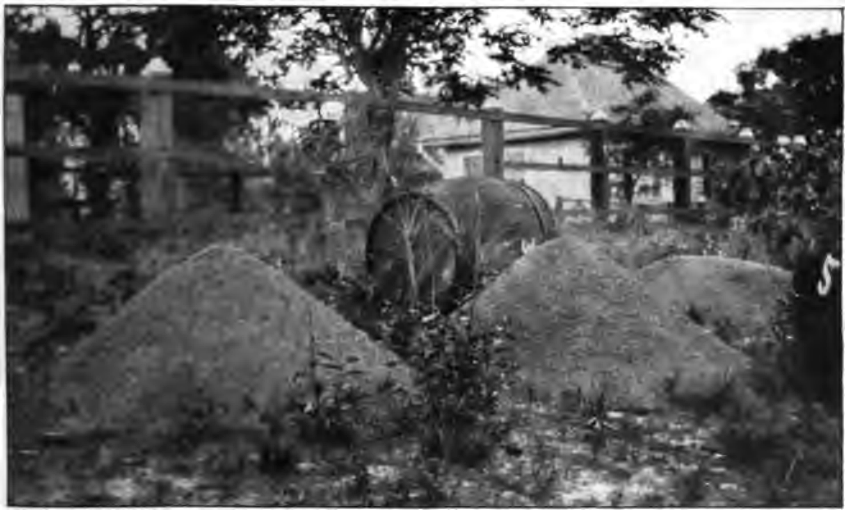

FIG. 7.—THREE SAWDUST PILES RESULTING FROM OVERTURNING AND EMPTYING A BARREL SAWDUST PRIVY, CLOSE TO THE ISOLATION WARD OF THE U. S. MARINE HOSPITAL, WILMINGTON, N. C.

The excreta are on the ground and are covered with the original sawdust. Not the slightest odor from the excreta could be detected two feet away, and no fly nuisance resulted.

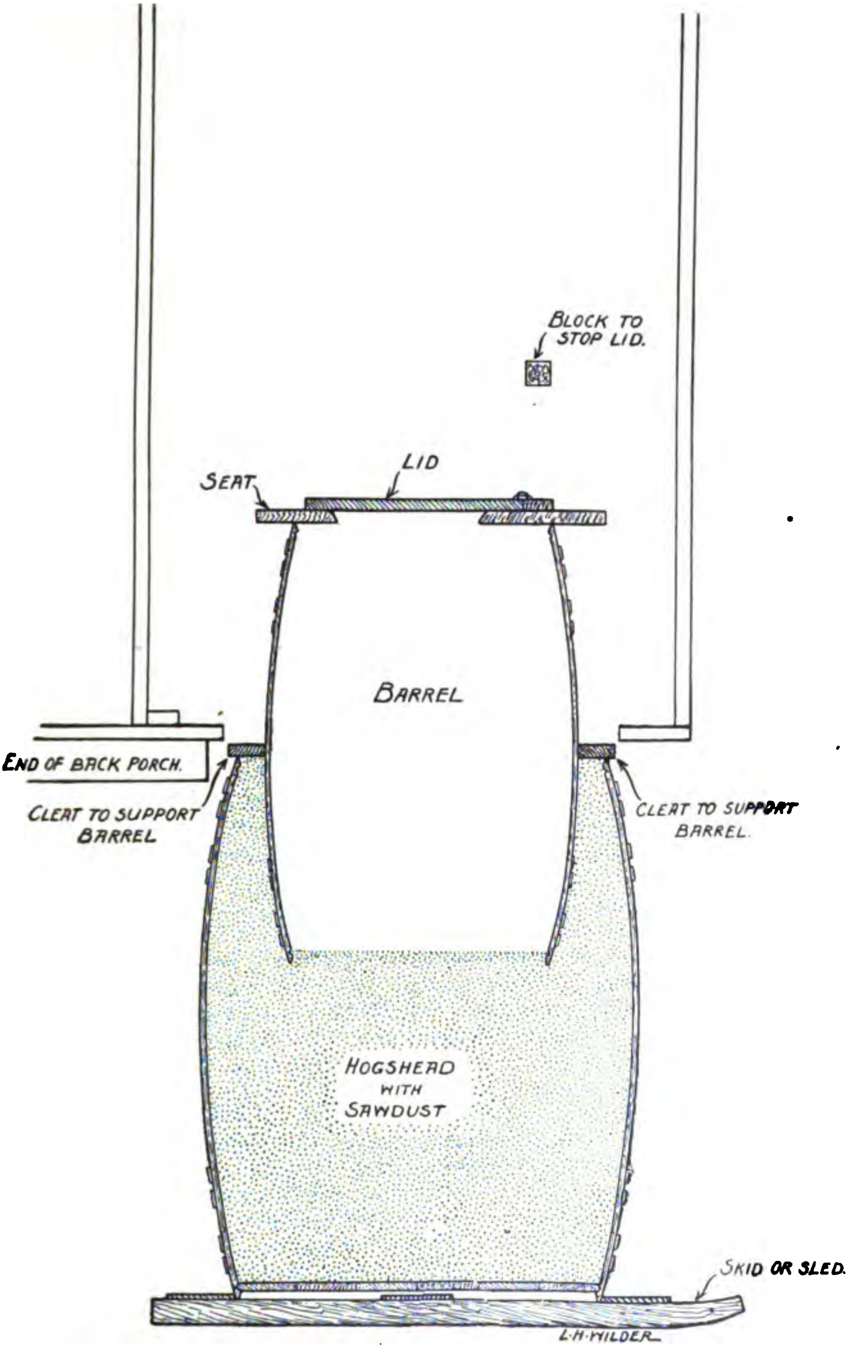

FIG. 6.—Diagram of construction of a barrel-sawdust-privy. Note the simplicity of the fly-proof construction.

(at present undetermined) number of months, but theoretically it can be left undisturbed for at least one, preferably two years. The hogshead is returned to place, the barrel is readjusted, new sawdust put in, and the privy is again ready for use.

Capacity.—A privy of this kind has been in experimental use at the Marine Hospital at Wilmington, from April 3 to May 22, 1920. There have been 100 defecations and 95 additional urinations during the 50 days in question; this gives an average of 2 defecations and 1.9 extra urinations per day. Not more than 10 per cent of the capacity of the privy was exhausted on May 22.

Estimating the excretions of a family of five persons as two quarts[1] per day, a privy of this type would require emptying approximately once every three months.

Advantages.—Among the advantages of this kind of a privy and method of disposal may be mentioned: Ease of construction; ease of fly-proofing; the ground water under the privy is protected from contamination far better than in case of either the pit or the surface privy, and equally with the bucket and water-tight vault; decrease in frequency of cleaning, as compared with the pail system; ease and cleanliness of cleaning as compared with the pail, the pit, and the vault; when the contents are dumped on the surface of the ground, the fluids sink to the ground, and the sawdust holds well against the rain; the surface of the sawdust dries by sun and by air drying, thus forming an unfavorable surface for hookworms; the fecal bacteria naturally wash down into the topmost layer of the soil and are thus farther away from the ground water than they are in a pit privy or if buried; the fresh sawdust layer on top is a good protection against flies, provided it is thick enough not to lamp wick the excreta to the top (in which case it is favorable to flies); the odor of the privy is not more than the odor from the other privies; the odor from the final disposal plant is nil or practically nil; the excreta are preserved to the ground as fertilizer; the construction, maintenance, and disposal are all about as "fool proof" as can be demanded or imagined; repairs are easy to make; materials on hand can be utilized.

Limitations.—This type of privy is limited to the availability of sawdust, barrels, and hogsheads. It is rather difficult to construct water-tight boxes, but if available, these might be substituted for hogsheads. If the hogshead leaks, the fluids seep through and attract flies, but this fault can be met by banking sawdust around the base. The units (one hogshead, one barrel) must be duplicated or cleaning must be done more frequently as the number of persons using the privy increases.

It has occurred to us that this general principle of prompt separation of the urine from the feces might be accomplished by use of pine needles, excelsior, chips, tan bark, chopped straw, leaves, sand, stones, and other similar materials in case sawdust is not available, but we have not tried these substances. Theoretically, sand and stones increase the labor of cleaning, and we would expect the materials, other than sand, to give more of a fly problem than does the sawdust, because the voids would be larger; in fact, in trying leaves and dried grass as a cover for pits we noticed that the larger voids gave us a condition distinctly more favorable for flies than has thus far been experienced with sawdust.

Type E: I stated that the "Surface open in back" or "Type E" privy could be improved. The improvement is not, however, sufficient to permit its recommendation, but only enough to permit its toleration in case we can do no better. You are all aware that some families use the "Type E" and cover the excreta more or less with ashes or dirt. Here again sawdust presents a new alternative. Its advantage in this case is that it is not so heavy to carry as are ashes or dirt. But none of these substances is satisfactory, for the reason that the excreta are not thoroughly covered, hence the fly problem remains, although the excreta when mixed with ashes, dirt, or sawdust are less disagreeable to scavenge than the unmixed excreta.

Sawdust and the pail system.—We are experimenting at present with sawdust in pails and large cans. Our observations have not yet reached a stage which justifies final conclusions, but certain facts may be safely stated. Sawdust in the pails decreases or eliminates the splashing and it is in so far an advantage. If the can is large enough, as an ash can, the frequency of scavenging is reduced, but the fly problem may be correspondingly increased under certain circumstances. The scavenging is less disagreeable, and the splashing in the scavenger's wagon as it goes along the street is reduced or eliminated. There is also some slight reduction in odor; but labor is increased because of the hauling of sawdust both to and from the privy. Whether or not the use of sawdust in cans is an improvement is therefore sub judice at present.

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[1] Based on measurements of a considerable number of can privies.

The privy as a flytrap.—Various persons have suggested the possibility of turning a liability into an asset by making use of the privy as a flytrap. Stiles & Miller (1911) captured 293 flies in 24 hours in a flytrap placed in a surface privy, and 1,742 flies in the same time in a similar flytrap placed in the dining room of the house to which the privy belonged. This demonstration does not appear to have been followed by a practical application of the opportunity suggested. Durrett (1918) has constructed a flytrap lid to privy seats, but the jarring of the lid, as it falls, seems to have limited the life of the trap.

In privy construction many health officers have insisted that the flue be screened to make it fly tight, although other health officers do not consider this at all necessary, since they do not believe that flies enter a privy through the flue.

I have long had in mind a plan to turn the privy flue into a flytrap, and the test has recently been made. A flytrap (figs. 8 and 9) is easily made out of ordinary screening, bent to fit the flue, into which it is inserted. This device serves to catch the flies entering or leaving the privy by way of the flue, does away with the necessity of extra flue screening, and is better than a screen, since the latter simply obstructs the passage of the flies while the trap catches them.

By placing a partition (figs. 8 and 9) in the equator of the trap we were able to keep record of the relative frequency of flies entering the privy and escaping therefrom by way of the flue. The records clearly show that flies do enter privies by way of the flues, that it is chiefly the female flies that enter, that several species (including the common house fly, *Musca domestica*) are involved, and in our observations thus far no fly has entered the traps in trying to effect an exit from the privy.[2] Of 346 flies captured in certain tests, 8 individuals (or 2.3 per cent) were males, and 338 specimens (or 97.7 per cent) were females. All of these went down the flue, but not one came up through the ventilator. The insects were doubtless attracted by the slight odor and from the fact that 97.7 per cent were females, the thought naturally suggests itself that the insects were seeking an opportunity to oviposit. Under this interpretation, the use of flytraps instead of screens in the flues would seem to be of value in reducing the amount of fly breeding in a village.

Some experiments in underground pollution.—One of the important problems in soil pollution involves the question as to the distance the pollution will travel underground from a point of deposit, for instance from a surface defecation, a leaking can or vault, or a mass of excreta buried in a trench or hole. The point at issue involves the combined active motility on the part of the germ, and passive spread by underground agencies, such as earthworms, crayfish, insects, and water. Some of the factors involved are exceedingly obscure, and the technique of study has not always been satisfactory. The technique our bacteriologist, Mr. Pfau, is now using seems to be satisfactory, and we are trying to push this side of the subject.

Probably all of us have long had a subconsciousness that the moisture of the soil and the element of time are the two great factors involved, that distance is an important element despite the fact that, other things being equal, it is of necessity secondary to moisture in importance, and that different types of soil present different problems. In fact, some of us have argued publicly along these lines.

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[2] Later note: By modifying the flue into a short horizontal pipe and doing away with the "upright," we have caught flies in both halves of the trap.

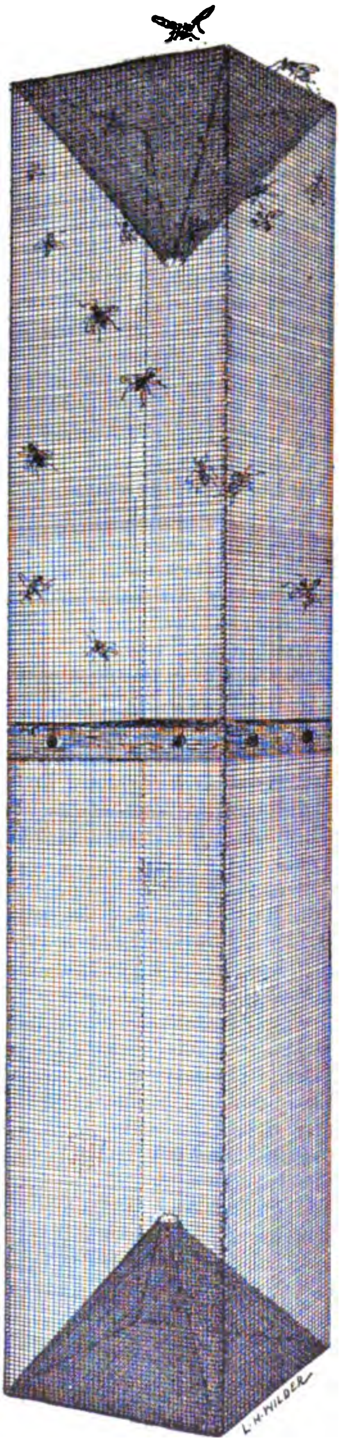

FIG. 8.—An experimental wire fly-trap for use in a privy flue.

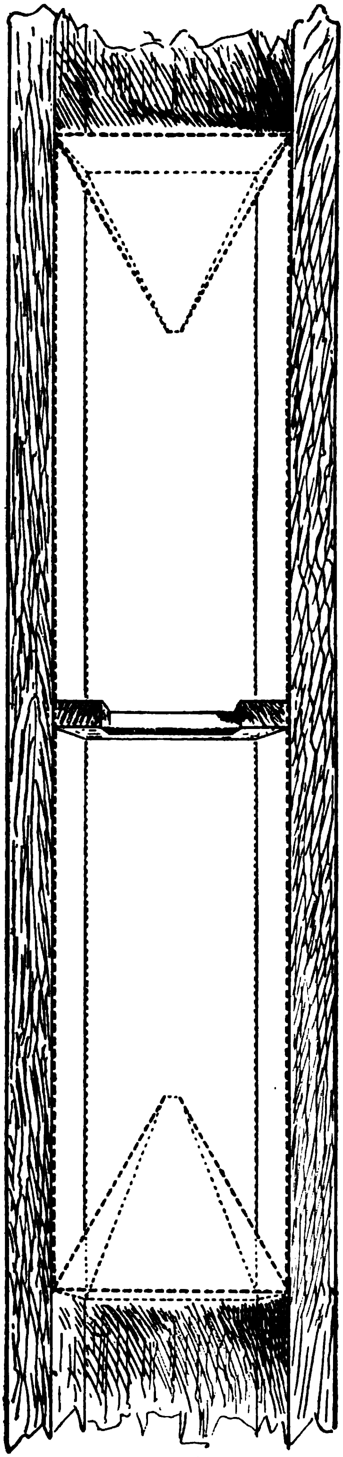

FIG. 9.—The fly-trap placed in the flue.

As fundamental premise, permit me to emphasize the point that dryness is inimicable to hookworm larvæ and typhoid bacilli. Given a thoroughly dry barrier of soil between a cracked concrete vault or a pit privy and a well, and the well is safe from pollution from the privy. As soon as the voids in the soil become sufficiently moist to permit active motility or passive floating of the germs through the voids, the question of danger arises, and time and natural enemies become factors of great importance. These live germs are always potentially dangerous, no matter where they are, but this potentiality is of no importance unless the medium in which they exist has sufficient moisture to permit them to spread. Elemental as this point is, it is fundamental and (leaving out of consideration the transportation by various animals such as earthworms, insects, etc.) it will bear emphasis as follows:

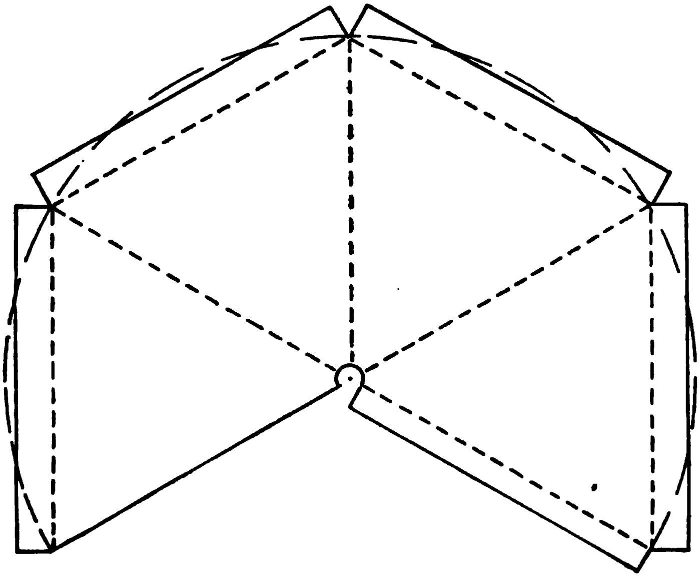

FIG. 10.—Diagram of outline for cone at ends of a flytrap to be inserted into a flue with square cross-section. Cut the wire screen along the solid lines, bend it along the dotted lines.

1. Moisture and time seem to be the factors of chief importance involved in the actual danger of the spread of potential infection in a privy.
2. Water-tight construction presupposes a surrounding layer (as concrete) of dryness, which, in addition to the minuteness of its voids, prevents the spread of infection.
3. A leaky vault privy is always potentially dangerous, but if surrounded by dry soil it is potentially safe.
4. Certain factors, such as rain or urine, may render this potentially safe leaky privy a dangerous one.
5. A pit privy is, potentially, a privy which leaks on five surfaces, but if the surrounding soil is sufficiently dry and extensive to form a barrier which is inimicable to the spread of the germs, it is practically safe. Its safety is, however, only relative, as in the case of a leaky vault, and time becomes the great factor involved.

Turning now from these theoretical considerations to experimental evidence, it may be stated in brief summary that in experimental work in sandy soil at Wilmington conducted by the board on excreta disposal—

1. It has been found possible to maintain an experimental pit privy for 4 months within 6 to 10 feet of wells without demonstrating bacterical pollution of these wells,

although chemical pollution with salt was washed through within 8 to 15 days. The bottom of the pit in this case is 8 feet above groundwater, and obviously the intervening barrier of sand is still sufficient to protect the groundwater. Time now remains an important element of the variable value of x.[3]

2. It has been found possible to trace perpendicular pollution down to 28 inches in the sand under a mass of excreta placed in experimental pits, but not recharged after once charged with excreta. Thus, without daily urinations, and with the pit covered so as to exclude direct rain, *Bacillus coli* sank 28 inches into the sandy soil.
3. It has been found possible to recover *Bacillus coli* in soil samples down as far as 60 inches (beyond which satisfactory samples could not be taken) below the bottom of an experimental pit within three days after it was charged, when flood conditions were simulated by running water into the pit.
4. It has been found possible to pollute the groundwater radially and to recover *Bacillus coli* up to a distance of 20 to 160 feet by sinking excreta pits into the upper layer of groundwater. Tests beyond 160 feet have not yet been made.

The important point which I desire to emphasize is that the various board of health rules prescribing the relative location of privies to wells and water edge are usually expressed in terms of distance only. Other things being equal, distance is of course an exceedingly important factor, but the factor of the moisture content of the voids in the soil is in reality fundamental in considering the location of permissible burial of excreta or installation of privies which are not water-tight.

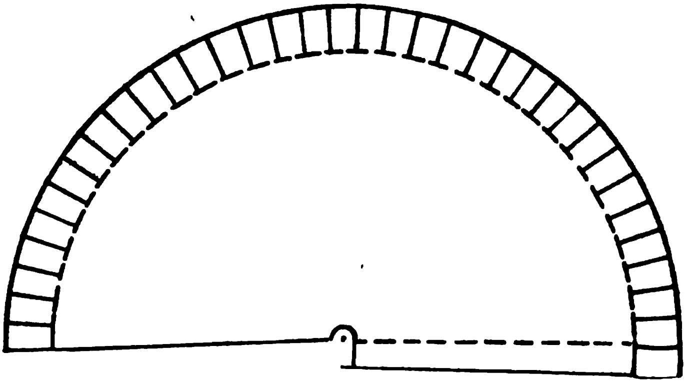

FIG. 11.—Diagram of outline for cone at ends of a flytrap to be inserted into a flue with circular cross-section. Cut the wire screen along the solid lines, bend it along the dotted lines.

AFTERNOON SESSION.

The conference reconvened at 2.30 o'clock p. m., Dr. Schereschewsky presiding.

Dr. SCHERESCHEWSKY. The meeting is called to order. I request that all guests of the conference leave their names and addresses with the reporters who are taking the proceedings.

When we adjourned at the noon hour Dr. Stiles had just concluded his interesting report on the work of the board on excreta disposal. I think that some of the results that Dr. Stiles has brought forth in his report are so interesting and give promise of such further advance in solving the problem of proper disposal of excreta in rural sections that his report merits the fullest and freest discussion. I would be very glad to have Dr. Rankin open the discussion on Dr. Stiles's paper.

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[3] Later note: "Time" has played its rôle, and wells up to 75 feet distance show pollution. The experiment is being repeated in order to confirm results or to detect some unknown error in the work.

Dr. RANKIN. I think this paper is one of the most instructive papers we have heard here within the last two or three days. There were three very important points brought out in this paper: First, the new type of closet with its many advantages which Dr. Stiles has described; second, the information which he has brought to us in regard to the distribution of coli in the ground; third, the interesting information in regard to the fly problem, that 97 per cent of the flies visiting the closet go there for breeding purposes.

I hope that the Public Health Service will see its way clear to continue this work and enlarge it when it becomes convenient. Of course, when we are dealing with the privy we are dealing with one of the four great sources of preventable disease. We have the preventable diseases carried by social contact, those carried by respiratory infections, those carried by insects, and the most important from the standpoint of results obtained from the money expended, the fecal-borne diseases. The work of this board is aimed at one of the main sources of disease, particularly for the warmer parts of the country, and I hope the work can be continued and enlarged.

Dr. HURTY. We all recognize that we have listened to a real scientific paper, a paper treating an important subject in a scientific way, and that means a great deal. Order and method and knowledge gained by his experiments were properly arranged and put in order so all could be handled and made practical. We all know that the disposal of human excreta upon the farm is one of the foremost of the rural sanitary problems. If that is not attended to it is of little use perhaps to attend to other problems. You might just as well let them go. We must teach the farmer that he must separate himself from his sewage. Of course, I am speaking of the average farmer. I have found that some farmers have a splendid system of sewage disposal. But many have a horrible abominable outside privy. Then, there is that terrible manure pile with its fly-breeding possibilities.

I have had some interesting experiences in regard to this matter. I talked to one farmer about his horrible outhouse, and asked whether the women of his household were not entitled to better treatment than that. He said "Oh, well, that is good enough for the women folks; we men don't go there, anyway." That is an instance of what you have to deal with. Another man who termed himself practical (he had amassed at least $100,000—that is the way we determine whether or not a man is practical) bought property in a little town called Waverly. It contained two interior closets, a bathroom, a very excellent water system, and the sewage was carried off to a distance and proper disposal made of it. The first thing he did was to tear out those inside closets. I said, "Why did you do that?" "Oh," he said, "the idea of having closets in a house." I told him that the hotels and all homes in cities are provided with these conveniences. He remarked "Well, just look what sort of people you have got up there, too." I tell these stories to show you what we have to contend with. Let us away with the horrible unsightly outside privy.

Dr. **Abercrombie.** I unfortunately did not hear Dr. Stiles's paper. I am very much interested in the type of toilet he has. We have 17 health officers in Georgia, full-time health officers; beginning January 1, 1920, we set a quota for them in building sanitary closets, of course, with their consent. This quota was to be 10,000 by the end of the year, and I am satisfied Dr. Stiles's type of closet will help us to reach that quota. There are only two objections I can see. I think they can be overcome. One is the inaccessibility of the sawdust. The other is that in many places the house would have to be raised to accommodate the type of closet. Rather than go up steps the people would not use it. It has so many good features to it, however, that I think we can very well adopt it.

Dr. **Stiles.** In regard to climbing steps to sit on the throne, that is a local question. If the toilet can be put on a hill or piazza, this will not be necessary. If put on the top of a hill the difficulty can be easily met. It is simply one of the many types that is applicable to certain localities. I would emphasize one point more than any other. We must get away from the idea that we can go into any one region and recommend any one type of closet for the entire region. For instance, for many of the people I would not hesitate to recommend a chemical toilet. Intelligent people can use a chemical toilet, but for the poorer rural population I think the money is largely thrown away. They are not up to it and you have got to consider the psychology of the people. In conclusion I would simply like to express the keen appreciation on the part of the board of the absolute freedom the bureau has given us in this work. If there has ever been a time in my 29 years of Government service that the supervising powers that be have made every concession and have allowed me a free hand, this is the time. The bureau has simply cut the red tape to the lowest limit and I would like to express publicly my appreciation of the kindness of the bureau in this respect.

Dr. **Schereschewsky.** The bureau may feel complimented in having exhibited a certain amount of common sense in the matter.

In the absence of the chairman of the conference, we will pass over the first subject on the program. The second matter has already been covered by Dr. Lumsden in the discussion of his paper. Passing now to the question of child hygiene, we have before us for discussion the bill for physical education which is being promoted by the National Physical Education Service. I will ask Dr. Rankin, from whom the suggestion was received, to open the discussion on the subject of the Fess-Capper bill. I will ask Dr. Rankin to explain the bill.

FESS-CAPPER BILL FOR PHYSICAL EDUCATION.

Dr. Rankin. I would rather have some member of the service discuss the Federal administrative phases of this bill and I shall restrict what I have to say to the bill as it relates to State health administration. Most of you have seen the bill, I believe, the first Capper bill; I have forgotten the number. It carries $10,000,000 appropriation which is appropriated to the States on a population basis and which makes provision for physical education. By the term physical education, I include the teaching of hygiene, certain recreational facilities about the schools, and the detection and treatment of physical defects of school children. I shall make no comment as to the relation to the Public Health Service of the administration of this bill, which is placed largely in the Bureau of Education of the Department of the Interior. I hope some member of the Public Health Service will discuss that phase of the bill. Coming now to the administration of the bill as it relates to State machinery, section 13 of the bill, it says that this act shall be administered in the States by the superintendent of public instruction or such other administrative agency as the general assembly of the State may designate.

The term "some other agency to be designated by the general assembly" is an amendment put in after conferences of the proponents of this measure with a number of State health officers. As the bill originally stood it placed the administration of the act within the States entirely under the department of education. As the bill stands to-day it suggests to the States that the act be administered by the department of education, but gives the State a little leeway and leaves it open for the general assembly to designate some other agency if it should wish to do so. Section 13 ought to read like this: "The agency to administer the act within the States shall be designated by the general assembly of the States," leaving the thing wide open to the States—a recognition of the vital principle of State sovereignty. You understand, I am only discussing this bill as it relates to State health administration. If a State wants to put that act under its department of education, let the State do it. If a State wants to put that act under the board of health, let the State do it. If it wishes to put the act under a joint committee representing both agencies, the State board of health and the department of education, let the State do it. But the States are getting tired of Washington's legislating for them, passing acts and naming the machinery for the States. That is the feature of this Fess-Capper bill to which I imagine all the State health officers object. If section 13 is amended so as to recognize in full the right of the State to designate its own machinery the bill will be thoroughly acceptable to the State boards of health.

I am just going to say this much on the Federal administration of the bill from the Federal standpoint. We would not have the trouble referred to in the States if the situation here in Washington was right. It is because we have five cabinet departments all trying to do health work. There is a tendency on the part of the Federal administration to carry this division in health work down into the States. Each one of those departments wants to create a subdivision or a State agency through which it can operate instead of through a single agency—the State board of health. The bill introduced under the Department of Labor—the Children's Bureau—attempts to do the same thing. That bureau attempts to designate the machinery in North Carolina which is to do the work in which it is especially interested—to create another State board of health. The reason for these bills being introduced here is because we have multiple agencies where we should have a single agency. If we would prevent the danger of a divided State health administration we must start here in Washington. We must have a coordinative Federal health administration, not a Federal health administration divided up between 10 departments and about 30 bureaus overlapping and duplicating. The trouble all arises here and the whole thing comes back to the fact that there are separate agencies here that want to extend themselves down into the State and perhaps into the counties. The cure for the whole trouble lies in Washington, not at the State capital and the cure is to get an enlarged and coordinated Federal health administration. I think the principle of the Fess-Capper bill is splendid. The only question is one of administration. We ought to have just what that bill provides, but we ought to have the administrative machinery, so provided that in North Carolina the department of education and the State board of health will be in absolute harmony and not in conflict.

Dr. SCHERESCHEWSKY. In order that we may get this matter fully before the conference, before we proceed I will ask Dr. Clark to mention the Federal features of the bill, and I may also add that while the public hearings on this bill have been concluded, the committee is by no means ready to report but has stated that it will accept statements and memorials from bodies interested in this matter and consider them in the hearings. At the hearing which took place recently there were no State health officers present to give their opinion on the administrative features of the bill, and I believe that if this body comes to some conclusion as to what their feelings are on the administrative features of the bill they would do very well to embody them in some resolution or other to be transmitted to the committee on labor and education in the Senate. I know those gentlemen are not prejudiced in favor of any form of administration and are ready to amend the bill if it seems that the best judgment requires its amendment.

Dr. CLARK. I think it would be well to explain to the gentlemen present how this bill came to be drawn. It was not drawn by the Public Health Service. In February, 1918, a conference was called by the Commissioner of Education to meet in Atlantic City, which was attended by representatives of a number of volunteer agencies engaged in health and welfare work throughout the country. As a result of this conference, a national physical education committee was appointed, and this was further divided at a subsequent meeting into a number of secondary committees, one of which was the committee on legislation which drafted this bill. In its present state the bill represents the maximum concessions which I myself, a member of the committee, was able to obtain from the educational authorities. The bill provides for several things, but essentially and primarily it provides for physical training in the schools of the country, and secondarily for medical inspection prior to the assignment of children to classes in physical training. It also provides for the training and employment of physical educators, including medical inspectors.

We must all recognize that the educational authorities have a certain right in the premises, that the child is compulsorily under their supervision, and that the child's physical condition has a marked bearing on his ability to take advantage of his educational opportunities. However, we must also recognize the fact that for a still longer period of time the health of the child is a problem of the health authorities of the country, hence the conflicting claims of the health and educational authorities as to which of them should exercise supervision of the health of the school children. In fact, both of them have a certain right in the premises, the one from the standpoint of restraint and control, the other from that of instruction.

If we are to profit by the experience of other countries which are pioneers in school hygiene work, particularly England, legislative bodies would put the administration of all health work in the schools in the hands of the health authorities.

Dr. Rankin has very emphatically brought out the point that there is great duplication of effort in Government bureaus. A rough estimate gives 33 different bureaus directly engaged in health work, and 37 indirectly. Any Government bureau, if it can get some one to introduce a bill, is at liberty to seek authority to extend its activities in all sorts of directions, irrespective of duplication.

Sections 9 and 10 of the Fess-Capper bill, providing for a division of child hygiene in the Bureau of the Public Health, have been objected to by one or two nongovernmental agencies on the ground that the establishment of such a division would cause the Public Health Service to duplicate the work of other Government bureaus. The service has long been engaged in studies of health problems relating to the child, has ample authority under existing statutes for such work, and desires the establishment of such a division for administrative purposes only. The bill grants no additional authority to the service to engage in health work.

I understand hearings on this bill will continue for a longer period. If this conference sees fit to pass resolutions regarding its health administrative features, I am quite sure they will be incorporated in the hearings of the committee.

Dr. McCormack. As long as Dr. Nicolls is not present and Dr. Hayne is not going to discuss this matter I should like to make a few remarks. I really believe this is the most important proposition next to the matter of Federal health administration, with which it is closely interwoven that is going to come before this conference or before Congress. The fundamental thing, the biggest thing in public health and in education in this country to-day, is physical education. Our educational system in the Federal Government needs revision quite as badly as our health administration needs revision. I want to say in admitting the criticism, which is perfectly just, that we are not the only ones at whom stones can be thrown without the perfectly obvious result of broken glass. I was particularly interested last week in the deliberations of that congress in which nearly everybody present took part. The result was 38 closely typewritten pages in the final session, which they hadn't had time to read. It was directed that the 38 pages should be adopted and transmitted to Congress as a Government bulletin. Nobody had ever read any of them except the man who wrote them. As long as education is going to be conducted like that, I am perfectly confident we don't want to submit the health problems with which we are acquainted at first hand to administration by such methods. Aside from that, it seems to me that in that law and every law affecting physical education, this fundamental statement should be made: In so far as it is educational and we should attempt in this law not mere training of the mind, that should be solely in the hands of the school authorities; but in so far as it is a health function, the relief of physical defects, and the control of communicable diseases, it should be solely in the hands of the health authorities.

But, in each instance, the administration should be done in cooperation with the proper authorities. It is absurd and ridiculous to assume that the Federal Government has failed for 135 or more years of its existence to appreciate the importance of coordinating its functions. I don't believe any other department of the Government ought to have any health functions. Our Congressmen are hearing a great deal about the demand for education. The people are hungry for that sort of thing. And yet we have been feeding them. Suppose this audience had been able when they went through school to have learned everything in every book that was offered to them as mental food in primary school and in the high school. If you had learned all that stuff you would have been ruined as useful citizens unless you were going to be teachers. It should be taken into consideration at the same time that some 80 per cent of the people that are started into this education mill are not going to pass the sixth grade of school. It seems to me that it is of the utmost importance that this organization of health officers shall go on record as distinctly insisting that physical education shall be the education that makes men understand the nobility of labor and makes them physically able to labor; that will train them away from the idea of converting themselves out of work but will enable them to have physical ability and the mental desire to work.

If we don't get back to that basic principle, we shall get nowhere as far as the future welfare of our country is concerned. We are confronted with a thousand plans for universal military training and every sort of thing that keeps people away from producing enough food to feed people. I believe in universal physical training and I believe it should be done during the school period and individuals should not be taken away from productive labor to make soldiers of them. I believe you can make soldiers out of any able-bodied man with normal physique and normal brain; he can defend himself and can attack if necessary. Until we have 95 per cent of that sort of man (instead of having 33⅓ per cent unfit, as now) we haven't got anywhere with our program. I believe the executive committee of the conference of State health officers should arrange to be represented before this committee of Congress and that there should be written into the bill the principle that so far as it is physical education it shall be administered by the educational authorities, and in so far as it is a health administration, it should be administered by the health authorities, and that in each case every agency shall cooperate.

Dr. Clark. I arise for a correction. I would not say they were right in doing this, yet if I were a member of one of these bureaus I would probably act in the same manner. From the standpoint of military training, the very excellent physical training provisions of this bill are in strong contrast with universal military training. Military training gets the child too late to prevent many physical defects, improper posture and its results. Military training takes cognizance of the male population only, whereas physical training in the schools is applied equally to boys and girls and from that standpoint it is a very much more excellent provision of a general law.

Dr. RANKIN. I should like to introduce the following resolution which meets the suggestions made by Dr. Clark and Dr. McCormack. You understand now that this motion has a second.

Resolved, That it is the sense of the eighteenth annual conference of the State and Territorial health authorities with the United States Public Health Service that the objects of the Fess-Capper bill for physical education be strongly indorsed; and be it further

Resolved, That it is the sense of this conference that the Federal administration of the said bill as it relates to the sanitation of school buildings and grounds and the detection and treatment of physical defects and diseases of school children should be under the direction of the United States Public Health Service; and be it further

Resolved, That section 13 of the said bill should be amended so as to leave to the legislative bodies of the States the designation of the State machinery through which the provisions of the bill shall be carried into effect within the States, and that subsequent sections of the said bill be amended to accord with the change in section 13; and be it further

Resolved, That this resolution be laid before the Committee on Education and Labor of the Senate and Committee on Labor in the House by a special committee representing this conference.

Dr. RANKIN. Dr. Clark suggested the addition of the word "mental" to the word "physical"—"physical and mental" defects.

Dr. LUMSDEN. The fate of so many resolutions is to lie in a pigeonhole. It should be communicated either by a special committee or by an assisting committee.

Dr. SCHERESCHEWSKY. All resolutions which are introduced should be referred to the resolutions committee to be reported to-morrow for the final action of the conference, at which time, of course, any amendment to the resolution will be in order on the floor.

Dr. LUMSDEN. I suggest, then, that Dr. Rankin introduce a resolution providing that a special committee convey the resolution to the chairman of the committee of the House and to the chairman of the committee of the Senate.

Dr. CAREY. I am wondering if there would be some phrase in that amendment to the effect that this should be continued on State law. In Massachusetts the inspection of public buildings is under the department of the State police. Under statute, certain functions were taken away from the State department of health. I am not quite certain that phrase was in that resolution.

Dr. SCHERESCHEWSKY. States which select their own method of administration of the law should dictate the machinery by which a law shall be put into execution. It is out of order for this conference to attempt to do the same thing.

Dr. CAREY. I believe inspection of buildings should be under the Public Health Service.

Dr. CLARK. I will reply to Mr. Carey that the statute leaves it to the legislature, so it automatically takes care of that phase which you mention. The legislature has the privilege and the power to do that.

Dr. SCHERESCHEWSKY. My attention has been called to the fact that many of the sanitary engineers attending this conference are under compulsion of catching an early train and for that reason, without objection, the program will be slightly changed, so that the subject "Coordination of effort and promotion of efficiency in field of sanitary engineering" will be considered next.

Dr. DRAKE. As a member of the committee on resolutions, may I suggest that all resolutions be submitted in writing at the earliest possible moment, so that the committee may have time to consider them?

COORDINATION OF EFFORT AND PROMOTION OF EFFICIENCY IN FIELD OF SANITARY ENGINEERING.

Dr. McLAUGHLIN. In regard to the coordination of effort and promotion of efficiency, I shall be very glad to say a word. I presume this refers to efficiency in sanitary engineering of the State officials and the Federal Government. As you know, the present policy of the Public Health Service in the control of water supplies involves the establishment and development in State health departments of strong divisions of sanitary engineering. We feel that while we are charged with the control of water supplies in interstate traffic and the prevention of the spread of disease in interstate traffic, this can best be accomplished not by building up a large Federal machine, but by utilizing the Federal forces to build up in each State, as nearly perfect as possible, a Department of Sanitary Engineering. This is a tremendous task, much larger than some of us think. Some of us may be deluded with the idea that we have now departments of sanitary engineering in all States. I question whether there are more than 8 or 10 States which have fairly satisfactory divisions of sanitary engineering. I may say there are 11 or 12 States that have no division of any kind of sanitary engineering. There are many States that have an alleged department that is perhaps a one-man department, which is perfectly futile. One man in the sanitary engineering department of the State perhaps without clerical help, without field agents, is apt to be worked to death. However, we must make a beginning. The Public Health Service has been directing its entire energies in sanitary engineering, as far as water is concerned, to the development of the State divisions, without attempting to enlarge the Federal machine. The two laboratory cars which the service formerly operated have been parked gracefully for use in epidemics.

The service hopes to develop in every State a strong division of this character. It is only necessary to point to the States like Massachusetts, Minnesota, Pennsylvania, New York, New Jersey, where they are strong on the engineering side, to show the results in disease prevention, and that this is an activity that pays; but we find that the best argument is to put in a demonstration in the State as we are now doing in Tennessee, an actual establishment with the training of personnel to carry it on, a demonstration the legislature will most likely understand and respond to. We hoped to have upon this work at least 25 sanitary engineers, but our appropriations were cut to a point where we were only able to have four, and with four men we were able to establish a running division of sanitary engineering in eight States which 18 months ago had no such department. Do not think for a moment that this work is only to be done in States where they have no division of sanitary engineering; there is work of this character to be done in every State in the Union. There is a certain division of that work which is no just charge against that State, i. e., the examination of water supplies used by railroads, and we have been beggars to that extent. We have been expecting the States to carry that burden for us. It is not fair and in such States it would be proper for the Federal Government to detail an engineer to compensate for the amount of work the State does that is put upon them by Federal law and regulations.

I wish to make a suggestion. I am very sorry, indeed, that this matter wasn't presented to the conference of the State health officers in the same clear and lucid manner that Dr. McLaughlin presented his subject, but the arguments were presented yesterday and have been presented for many years before the State health officers' conferences. The head of every division of the Public Health Service has appeared before us with this same swan song. Each one thinks his department is the only department in the Federal Health Service. I presume that the venereal disease men would resent the fact that the State health officers know more than they do about their various branches. I believe that our engineers are as competent as the heads of other bureaus in various departments. I think the sanitary engineer is one of the most important. I have the utmost confidence in our engineers. When they submit propositions to our State board of health, they are submitted with the confident and definite knowledge that they are going to be approved. The conference of State health officers is just a conference of executives, and I am sure that Dr. McLaughlin unintentionally expressed the idea that while State health officers were competent to dabble in all other bureaus, but they ought not dabble with the engineers. I am sure that no engineering division is so secret that the State health executive can not exert his influence among them, and when they do become so, they ought to be created into a State engineering department.

When the State health department attempts to coordinate the work of all of them and to see that that work is properly guided and coordinated, just so soon the State health executive fails to be a State executive. This is a conference of State health authorities and not a conference of other authorities in the State. I believe that from time to time the engineering phase is being emphasized. The conference of State health executives is a conference of State health executives and I do not believe that there is a dissenting opinion among them all that it will ever be anything but a conference of State health authorities. Next to that I want to commend particularly the action of the service in its real constructive effort toward assisting the States in properly emphasizing the engineering work and in properly recognizing the work that has been done. Most of the public water supplies, almost 75 per cent of the school water supplies in this country, are bad. The only relief that will come is through the engineers. There is no question that our disposal of sewage in the large majority of cities, small towns, and farms of this country, is bad, and the solution will come from wise action of our engineers; but it is very important that no solution has so far been presented for the problem of the individual home except by the coordinative work of the health officers with the engineers, and not by the engineers alone. The kind of education that our engineers have leads them to see all the defects, all the dangers, and to guard against all of them, so they devise a plan complicated and expensive and impracticable, in so far as the solution of the real problem is concerned. I don't believe for one moment that the function of any one bureau of the State health department should be emphasized at the expense of any other State bureau.

If serology is important, it is important that we bring our bacteriologists here, if the venereal disease bureau is important, we should bring our directors of venereal diseases here, and in a very short time when child hygiene is established, it will be important to have the directors of our child hygiene work brought here. We will want housing bureaus and other things. I don't believe that we should arrange to have the heads of all the bureaus come to Washington. Our appropriation is not sufficient to defray their traveling expenses and at the same time keep them at work back at home.

SHEPPARD-TOWNER BILL FOR PUBLIC PROTECTION OF MATERNITY AND INFANCY.

Dr. **Schereschewsky.** If there is no further discussion, we will take up the next thing on the program, and if the chair will be permitted I will present this bill to you, the provisions of which most of you are familiar with at this time. It is well known that the Sheppard-Towner bill has for its object the protection of maternity and infancy of the country. I think all health authorities are justly under the impression that we haven't done enough for the children up to the present time. We ought to do ten, twenty, or thirty times as much as we are doing now. For it is a self-evident proposition that when one-fifth of all the deaths are in the first five years of life, it is here that we have the greatest opportunities for the conservation of the health of the community. The protection of maternal and child life presents a problem that has been with us ever since we have been a republic, a problem which we have not yet succeeded in attacking in a comprehensive way. We have only improved conditions, because of the general advance in economic and sanitary conditions. While this bill has the most worthy of all objects which we can do our utmost to promote, it has the same administrative defects as the bill for physical education. We find in the bill provisions for continuing appropriations, beginning with $450,000 in one year up to a maximum of $4,000,000, to be attained five years from the first passage of the bill, to be allotted to States for the purpose of promotion and protection of maternity and infancy, and of course those sums, compared with what it is desired to effect, are very modest appropriations. I think as Federal health officers and State health officers we can, perhaps, find ground for fruitful discussion in the administrative features of this bill. As you are probably aware, this bill proposes to create a Federal Board of Maternity and Infant Hygiene which is constituted as follows: The Secretary of Labor, who shall be chairman; the Chief of the Children's Bureau, who shall be executive officer, and as a very minor and possible concession to the existence of a Federal Public Health Service—which so far as Federal health agencies exist has been recognized by Congress and laws enacted in 1798 as a Federal agency—the last and most subsidiary member is the Surgeon General of the Public Health Service.

As the State agency the bill proposes to create a State board of maternal and infant hygiene. In the original draft of this bill this board was to be appointed by the governor of the State, and consisted of a physician, a nurse, and one member of the State board of health. That, of course, created such instantaneous opposition among the State health officers that the proponents of the bill modified it in a way they thought might suit; so that as this bill now stands, the board is to consist of not less than three members, who shall have all necessary powers.

It seems that the State board of health may be permitted or directed to administer the State features of this act. Such, then, gentlemen, are the State administrative provisions of this act. Nowhere in this act, except in the position of a minority leader on this Federal board, is the Surgeon General of the Public Health Service or the Federal health agency mentioned. As a member of the Public Health Service, and one who believes that both in the Federal Government and in States, all health functions should be centralized in some central agencies, it seems to me that this bill is vitally defective. It certainly has as its logical conclusion the erection of separate health agencies both in the Federal Government and in States for the several age groups of the population. If we follow out the principle laid down in this bill we should not have in the Federal Government one department of health, but at least six or seven separate departments of health, of which the first would have for its care the expectant mother; the next, with similar departments in the States, the infants; the third, the child of the preschool age; the fourth, the child of school age; the fifth, for young adults; the sixth, for adults; and the seventh, for old people. Such are the general provisions of this bill. To us it seems vitally defective, and we shall be very glad to have this matter freely discussed and the reaction of the State health departments set forth plainly on this matter.

Dr. HURTY. From whom does this bill emanate?

Dr. SCHERESCHEWSKY. From the Children's Bureau.

Dr. CLARK. I should like to call to the attention of this conference that during the hearings on these two bills there developed the fact that the majority of the leading women organizations of the country are greatly misinformed as regards the functions of the health authorities, both Federal and State. I do not believe that these women have been properly enlightened as to the true facts of the case. I furthermore do not believe that when properly enlightened you will find them following any leadership blindly. I believe enough in the common sense of the womanhood of this country to be convinced that they can stand on their own feet and think for themselves. Being a married man I can testify most feelingly on this point. I have attended a number of the hearings on these bills when representation was made to the committee that to vest the Federal administration of their health provisions in the Public Health Service would be to duplicate the work of other bureaus. In fact, at a hearing on the Fess-Capper bill for physical education, the representative of the National League of Women Voters stated that the league indorsed the principle of the bill for physical education at a time when the actual text of this bill was not available;

and since the bill had been formulated and printed it was discovered that the bill provided for the establishment of a division of child hygiene in the Bureau of the Public Health Service, which it was felt should be strongly opposed. However, this sentiment is not universal, because I have at hand the text of a resolution by at least one State league recommending to the National Congress the indorsement of not any specific bill, but the general principle of the establishment of a department of health to administer all the health work of the Government.

Furthermore, there seems to be an insidious propaganda, which may or may not be intentional, that is particularly misleading, regarding functions of the constituted health authorities of the country. Indeed, I have in my hand a confidential communication reporting a public meeting at which a vicious attack was made upon the Public Health Service which was full of misleading misinformation which served as the basis of resolutions which purported to represent the thought of the women of this country. I do not believe this attack received official sanction.

Dr. **Dowling.** I move that we instruct the resolutions committee to draw up a resolution regarding the subject under discussion. (Carried.)

Dr. **Clark.** This is one time that we are able to appear before you with a statement of something accomplished. And this has been due to the fact that we have had more liberal appropriation of funds for child hygiene activities. In the address by Dr. Farrand, of the American Red Cross, before the conference of State and provincial health officers, I was struck by his statement that there is no longer need for investigations, and his interpretation of that statement. That brought to my mind a statement by Sir George Newman in an article entitled "Public Opinion on Preventive Medicine," to the effect that as the science of government becomes more representative of the aspirations of the people, so it becomes more dependent upon their education and equipment. So far as public health administration is concerned, I feel that this is the crux of the whole situation. He goes on to define education of the public from the standpoint of public health administration as teaching the people to secure and preserve health, to avoid disease, and to assent to sanitary control and sanitary government.

We must create a State-wide sentiment in favor of any public health movement if we are to be successful. We must get the consent and assent of the people at large, and to do this they must be educated in these matters. In my opinion the best way to educate a people in health matters is by conducting State-wide investigations, studies, and demonstrations, the whole people cooperating with the constituted health authorities.

Owing to legal restrictions regarding the expenditure of public funds for child hygiene work, limiting it largely to studies and investigations, we are particularly concerned with the value of work of this character as an educational instrument.

Our child hygiene activities during the present fiscal year have been investigative in character, some of them research, and some informational.

Last December the Surgeon General addressed a questionnaire to the various health officers throughout the country requesting certain information in respect to the child hygiene laws and the child hygiene activities of the various departments of health, including the medical inspection of schools. It will be of interest to you to hear the result of some of our compilations of the answers to these questionnaires, particularly as regards school medical inspection, because of the conflicting claims of State educational and health authorities regarding jurisdiction over health supervision of school children. In 14 States the law provides for cooperation of State boards of health with the State boards of education in school medical inspection; in 6 States the health supervision of school children is exercised by the educational authorities alone; in 9 States by the health authorities; in 21 States the local administration of the school laws is vested in the school authorities and in 2 in the local health authorities; in Connecticut, Florida, Indiana, Massachusetts, North Carolina, Ohio, and Wisconsin the local administration varies with local conditions, and is a joint one. In 4 States the law permits counties and local units to employ public health nurses who can do school nursing, and in 10 States the general laws are indefinite, but are permissive as regards local units.

School medical inspection is mandatory in 17 States, conditionally mandatory in 6 others, permissive in 6, and conditionally permissive in 2.

I think this is interesting, showing as it does the lack of uniformity of method, of definite responsibility, and almost entire absence of appreciation of the immensity of the problem of providing adequate facilities for the detection, correction, and prevention of physical defects among school children.

The research work conducted during the year has been primarily concerned with a study of the usability of dried milk products as a food for infants exclusively on the bottle. This work was begun last August, and is being carried on in Boston, in cooperation with the Boston Baby Hygiene Association and several other agencies. No child over 6 months of age is enrolled, and those enrolled must be exclusively on artificial food. For purposes of study these infants are divided into three groups.

Group 1 fed exclusively on grade "A" market milk, group 2 fed on reconstructed milk made by the mother in the home from whole milk powder containing 3½ per cent butter fat, and group 3, comprising infants fed on reconstructed milk made by the addition and emulsification of butter fat in the required proportion. This latter is made and delivered by one of the leading dairies of the city of Boston. Careful supervision is maintained over all the children, who are weighed periodically. Contrary to expectation, as measured by gain in weight, the children fed on reconstituted milk, mixed by the mother according to formula, did better as a whole than those of any other group.

The first part of this study was devoted primarily to determining the usability of milk powder, and secondarily to accustoming the mothers to the use of this type of food in order that infants in larger numbers might be enrolled for a more scientific investigation. The work has now been extended to include studies of the intestinal flora of the infants of all three groups, laboratory examinations of the various forms of milk employed in feeding both before and after the reconversion, studies of metabolism of a selected number of infants, periodic physical examinations, and a sociologic study of homes from which these children have been recruited.

Through the courtesy of Dr. Milton J. Rosenau the facilities of the Harvard Medical School laboratories have been placed at the disposal of the service, and through Dr. Fritz B. Talbot the laboratories of the Massachusetts General Hospital have been utilized for studies in metabolism.

These studies after being carefully checked up will be presented as the last word in the use of these products as a food for infants. I can conceive of the economic possibilities and importance of its use in certain sections of our country where dairy farming is not practiced and where the milk supply is limited.

At the last meeting of the Legislature of the State of Delaware an act was passed providing for the Delaware reconstruction commission for child welfare, which was placed under a nonmedical directorship and the sum of $50,000 was appropriated for its maintenance. After this commission had been in operation for a considerable length of time and a number of child health clinics had been established in Wilmington, the Public Health Service was appealed to for assistance in carrying on its work. An officer was assigned to cooperate with the commission to assist in the proper conduct of this work and in making recommendations to the legislature for the permanent organization of child welfare wórk in the State of Delaware. As a result of our work the number of health centers has increased, wider publicity has been given to child welfare work, and there has been secured from private sources $16,000 for the organization and establishment of two school dental hygiene units to operate in the schools of the State. The service representative has been appointed medical director of the commission and has also been appointed by the State board of education director of its school medical inspection work.

In response to the request of the State board of health of West Virginia and of the State board of education, we sent a mobile dental hygiene outfit to this State, which comprised a dental surgeon well qualified to preach and practice the doctrine of mouth hygiene as related to school children; an assistant for prophylactic work; a portable dental outfit; a moving-picture film; and a supply of toothbrushes and tooth paste generously donated by the American Red Cross. This unit was instructed to visit the county seat or the principal town of as many counties as possible during the school year. The work consisted of (1) examination of mouths of selected groups of children to demonstrate to the people of the community the problem, (2) demonstrations of dental prophylaxis and the conduct of toothbrush drills as a training for teachers and children in mouth hygiene, (3) projecting moving-picture film at which time brief talks were given on mouth hygiene, and (4) conferring with the local health and school authorities and influential citizens with a view to inducing the community to purchase a dental outfit, secure a full-time dentist, and use the county seat as a base to extend dental facilities to the sadly neglected children of the more remote districts. This work has resulted in the establishment or promise of establishment of at least 14 school dental clinics in the State.

Work in Maryland has been largely with school children. School inspection work has been conducted in 73 schools of Cecil County, in which over 3,000 were given physical examination and approximately 200 children, reported by the teachers as in need of such examinations, were examined mentally. In addition to the inspection work numerous addresses were given on timely health subjects; public health literature was distributed to the parents along with notification of physical defects, and in a number of instances follow-up work was done by a temporary school nurse. This work has resulted in very widespread interest in the question of health supervision of school children throughout the country, and a school nurse has been engaged to assume charge of this work with the beginning of the next school year.

In the city of Baltimore the service has been cooperating with Dr. McCollum, of the Johns Hopkins University, in nutritional studies of a number of children judged to be suffering from malnutrition, as determined by ratio of height to weight for given age periods. Early in the school year Dr. McCollum had approximately 10,000 school children in congested districts in the city of Baltimore weighed and measured, and of this number about 1,500 were considered under weight, according to available standards. These underweight children were given an intensive physical examination by service officers, and a certain group of them was selected by Dr. McCollum for follow-up work in their homes. This consisted largely in advice to the parents regarding rest, exercise, mastication, hours of sleep, ventilation, proper foods, and balanced diets. In some instances the mothers were advised as to the making of a family budget and in the choice and preparation of foods. In no instance was the income of families supplemented or any food bought. It is hoped by periodic weighings and measuring in connection with this follow-up system to establish a practical method of overcoming defects of malnutrition.

The service selected about 275 children from this group who were found suffering from one to five more or less remediable physical defects, for the purpose of having these defects corrected with the consent of the parents and determining, by means of periodic weighings before and after correction, the effect of them on growth and development. This work has been progressing finely, but it is too early to give any report of significant results.

In response to the request of the State board of health and the request of the acting governor of Missouri, we have been conducting a State-wide investigation of child hygiene in this State. Dr. Jones, the State health officer, and Dr. Knight, who represents the service in this work, are present and will tell you in greater detail what has been accomplished. We have avoided, in every instance where possible, going into a community where there was not a fair prospect of the community putting into effect such measures as were recommended by officers of the service with the approval of the State board of health. A number of communities, as Dr. Knight will tell you, have engaged in some form of child-health work at local expense. Furthermore, we have succeeded in taking advantage of the potentialities of the voluntary organization in Missouri with greater success than heretofore has ever been done in any State. A number of volunteer agencies have joined with the Public Health Service and coordinated their activities to one common end with those of the State board of health.

In response to the request of the judge of the juvenile court of the District of Columbia, the service has undertaken mental and physical examinations of the delinquents appearing before this court as a part of an investigation of mental hygiene relating to the children of the country. A commissioned officer has been assigned for the mental examination of these delinquents, assisted by a woman physician, appointed as acting assistant surgeon, to make physical examination of girls. In addition to these examinations, routine examinations were made from the standpoint of incidence of venereal infection, including smears for gonococci and Wasserman tests. Furthermore, through the generosity of the District of Columbia Chapter American Red Cross a psychiatric social worker has been added to this force for follow-up work in the homes.

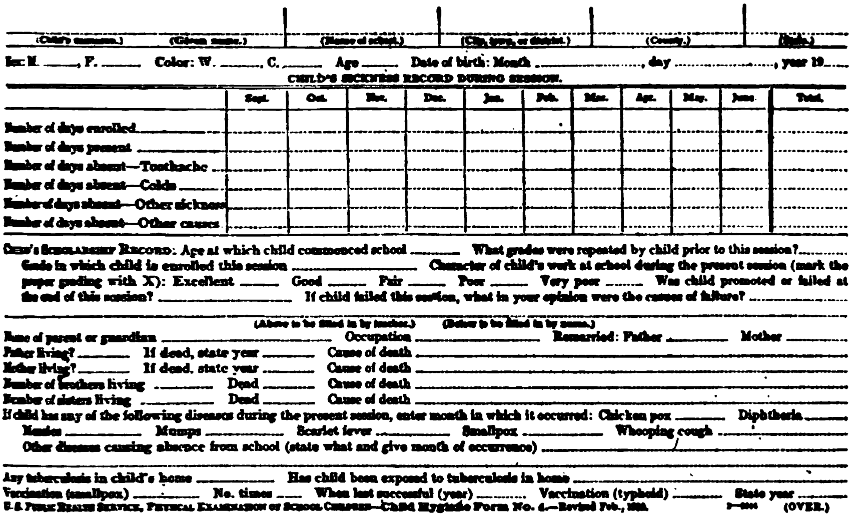
I am not going to take up the time of this conference to describe in detail this work, but I crave indulgence to the extent of being allowed to report a part of one week's work which is typical of the whole work. During this week 32 white males were before the court on truancy charges, disorderly conduct, incorrigibility, grand larceny, petty larceny, indecent assault, and forgery. These children ranged in age from 10 to 16 years. According to mental examinations, 13 of these were normal mentally, 6 were retarded, 5 were mental defectives, and 7 were constitutional psychopathic inferiors, and one a case of dementia precox.

Some one stated the other day—I think it was Dr. Freeman—that we do find cases of insanity among children. Indeed, in the course of my investigations I have found quite a number of insane children, or children potentially insane, who were attending school, which findings serve to emphasize the importance of mental hygiene in children.

In the State of Oregon we are conducting as a part of our mental hygiene work a State-wide survey of the feeble-minded, delinquent, and dependent classes. This work was undertaken on the request of the University of Oregon, which is conducting this survey in response to a resolution of the State legislature. This request received the indorsement of the State health officer. We are attempting in Oregon a thing which has never been attempted before; that is, to get the whole State of Oregon interested in helping us make this survey. We are enlisting the aid of doctors, lawyers, teachers, and preachers, and other prominent citizens, and also social-service workers and volunteer organizations in filling special cards relating to these classes and returning them to the service officer who is director of the survey. Later experts are sent to selected districts to confirm these reports. What is the effect of this? According to the State constitution, the enactments of the legislature for new work carrying an appropriation must be submitted to the people. By the methods which we are following in conducting this survey we are educating the people of the State regarding the problems of these classes of the population, so that any new laws relating to them which may be passed by the next legislature as a result of the recommendation based on this survey will receive ready indorsement when finally submitted to the people.

In conclusion, I should like to say a few words regarding the standardization of field-investigation forms. When we first started our investigations in Missouri, it became necessary to devise cards for recording data which would help us to evaluate the needs of different communities and serve as a basis of recommendation to a community regarding the nature of child-hygiene work which should be undertaken.

The first card (I have here for each of you gentlemen a complete set of these cards) is known as the family schedule card.



(Child's surname.) (Given name.) | (Name of school.) | (City, town, or district.) | (County.) | (State.)

Sex: M. ______, F. ______ Color: W. ______, C. ______ Age ______ Date of birth: Month ____________, day ____________, year 19____

CHILD'S SICKNESS RECORD DURING SESSION.

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
Number of days enrolled											
Number of days present											
Number of days absent—Toothache											
Number of days absent—Colds											
Number of days absent—Other sickness											
Number of days absent—Other causes											

Child's Scholarship Record: Age at which child commenced school ______ What grades were repeated by child prior to this session? ______ Grade in which child is enrolled this session ____________ Character of child's work at school during the present session (mark the proper grading with X): Excellent ______ Good ______ Fair ______ Poor ______ Very poor ______ Was child promoted or failed at the end of this session? ____________ If child failed this session, what in your opinion were the causes of failure? ____________

(Above to be filled in by teacher.) (Below to be filled in by nurse.)

Name of parent or guardian ____________ Occupation ____________ Remarried: Father ______ Mother ______

Father living? ______ If dead, state year ______ Cause of death ____________

Mother living? ______ If dead, state year ______ Cause of death ____________

Number of brothers living ______ Dead ______ Cause of death ____________

Number of sisters living ______ Dead ______ Cause of death ____________

If child has any of the following diseases during the present session, enter month in which it occurred: Chicken pox ______ Diphtheria ______ Measles ______ Mumps ______ Scarlet fever ______ Smallpox ______ Whooping cough ______

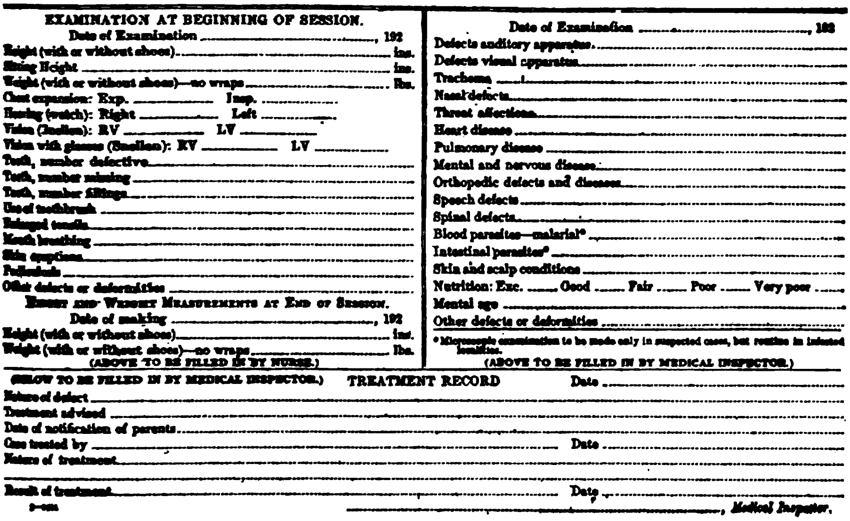
Other diseases causing absence from school (state what and give month of occurrence) ____________

Any tuberculosis in child's home ______ Has child been exposed to tuberculosis in home ____________

Vaccination (smallpox) ______ No. times ____ When last successful (year) ______ Vaccination (typhoid) ______ State year ______

U. S. Public Health Service, Physical Examination of School Children—Child Hygiene Form No. 4.—Revised Feb., [illegible] [illegible] (OVER.)

FIG. 12.



EXAMINATION AT BEGINNING OF SESSION.

Date of Examination ____________, 192

Height (with or without shoes) ____________ ins.

Sitting Height ____________ ins.

Weight (with or without shoes)—no wraps ____________ lbs.

Chest expansion: Exp. ______ Insp. ______

Hearing (watch): Right ______ Left ______

Vision (Snellen): RV ______ LV ______

Vision with glasses (Snellen): RV ______ LV ______

Teeth, number defective ____________

Teeth, number missing ____________

Teeth, number fillings ____________

Use of toothbrush ____________

Enlarged tonsils ____________

Mouth breathing ____________

Skin eruptions ____________

Pediculosis ____________

Other defects or deformities ____________

Height and Weight Measurements at End of Session.

Date of making ____________, 192

Height (with or without shoes) ____________ ins.

Weight (with or without shoes)—no wraps ____________ lbs.

(ABOVE TO BE FILLED IN BY NURSE.)

Date of Examination ____________, 192

Defects auditory apparatus ____________

Defects visual apparatus ____________

Trachoma ____________

Nasal defects ____________

Throat affections ____________

Heart disease ____________

Pulmonary disease ____________

Mental and nervous disease ____________

Orthopedic defects and diseases ____________

Speech defects ____________

Spinal defects ____________

Blood parasites—malarial* ____________

Intestinal parasites* ____________

Skin and scalp conditions ____________

Nutrition: Exc. ____ Good ____ Fair ____ Poor ____ Very poor ____

Mental age ____________

Other defects or deformities ____________

* Microscopic examination to be made only in suspected cases, but routine in infested localities.

(ABOVE TO BE FILLED IN BY MEDICAL INSPECTOR.)

(BELOW TO BE FILLED IN BY MEDICAL INSPECTOR.) TREATMENT RECORD Date ____________

Nature of defect ____________

Treatment advised ____________

Date of notification of parents ____________

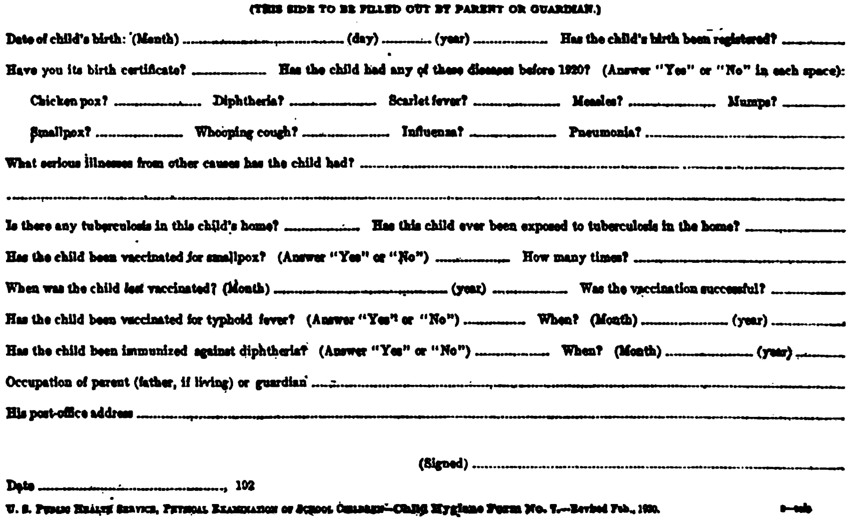
Case treated by ____________ Date ____________

Nature of treatment ____________

Result of treatment ____________ Date ____________

[illegible] ____________, *Medical Inspector.*

FIG. 13.



(THIS SIDE TO BE FILLED OUT BY PARENT OR GUARDIAN.)

Date of child's birth: (Month) .... (day) .... (year) .... Has the child's birth been registered? ....

Have you its birth certificate? .... Has the child had any of these diseases before 1920? (Answer "Yes" or "No" in each space):

Chicken pox? .... Diphtheria? .... Scarlet fever? .... Measles? .... Mumps? ....

Smallpox? .... Whooping cough? .... Influenza? .... Pneumonia? ....

What serious illnesses from other causes has the child had? ....

....

Is there any tuberculosis in this child's home? .... Has this child ever been exposed to tuberculosis in the home? ....

Has the child been vaccinated for smallpox? (Answer "Yes" or "No") .... How many times? ....

When was the child *last* vaccinated? (Month) .... (year) .... Was the vaccination successful? ....

Has the child been vaccinated for typhoid fever? (Answer "Yes" or "No") .... When? (Month) .... (year) ....

Has the child been immunized against diphtheria? (Answer "Yes" or "No") .... When? (Month) .... (year) ....

Occupation of parent (father, if living) or guardian ....

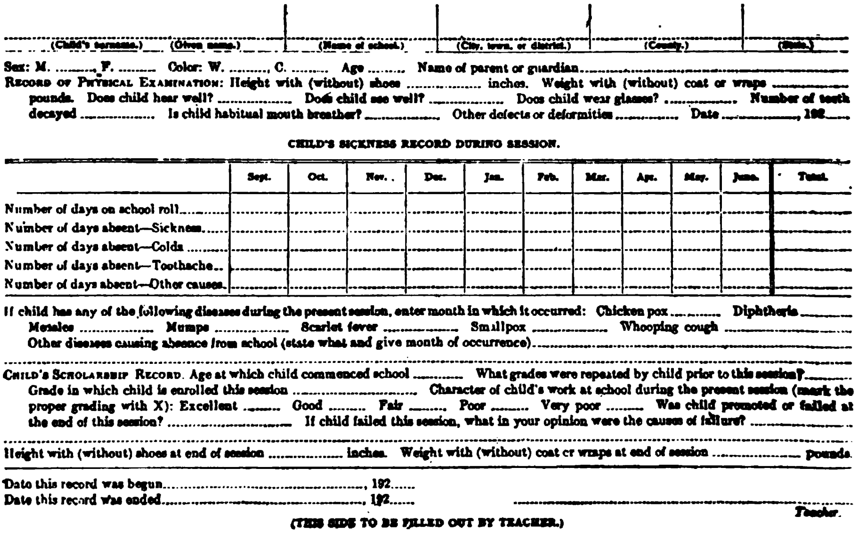
His post-office address ....

(Signed) ....

Date ...., 102

U. S. Public Health Service, Physical Examination of School Children—Child Hygiene Form No. 7.—Revised Feb., 1920. [illegible]

FIG. 14.



(Child's surname.) (Given name.)	(Name of school.)	(City, town, or district.)	(County.)	(State.)

Sex: M. ...., F. .... Color: W. ...., C. .... Age .... Name of parent or guardian ....

RECORD OF PHYSICAL EXAMINATION: Height with (without) shoes .... inches. Weight with (without) coat or wraps .... pounds. Does child hear well? .... Does child see well? .... Does child wear glasses? .... Number of teeth decayed .... Is child habitual mouth breather? .... Other defects or deformities .... Date ...., 192....

CHILD'S SICKNESS RECORD DURING SESSION.

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
Number of days on school roll											
Number of days absent—Sickness											
Number of days absent—Colds											
Number of days absent—Toothache											
Number of days absent—Other causes											

If child has any of the following diseases during the present session, enter month in which it occurred: Chicken pox .... Diphtheria .... Measles .... Mumps .... Scarlet fever .... Smallpox .... Whooping cough .... Other diseases causing absence from school (state what and give month of occurrence) ....

....

CHILD'S SCHOLARSHIP RECORD. Age at which child commenced school .... What grades were repeated by child prior to this session? .... Grade in which child is enrolled this session .... Character of child's work at school during the present session (mark the proper grading with X): Excellent .... Good .... Fair .... Poor .... Very poor .... Was child promoted or failed at the end of this session? .... If child failed this session, what in your opinion were the causes of failure? ....

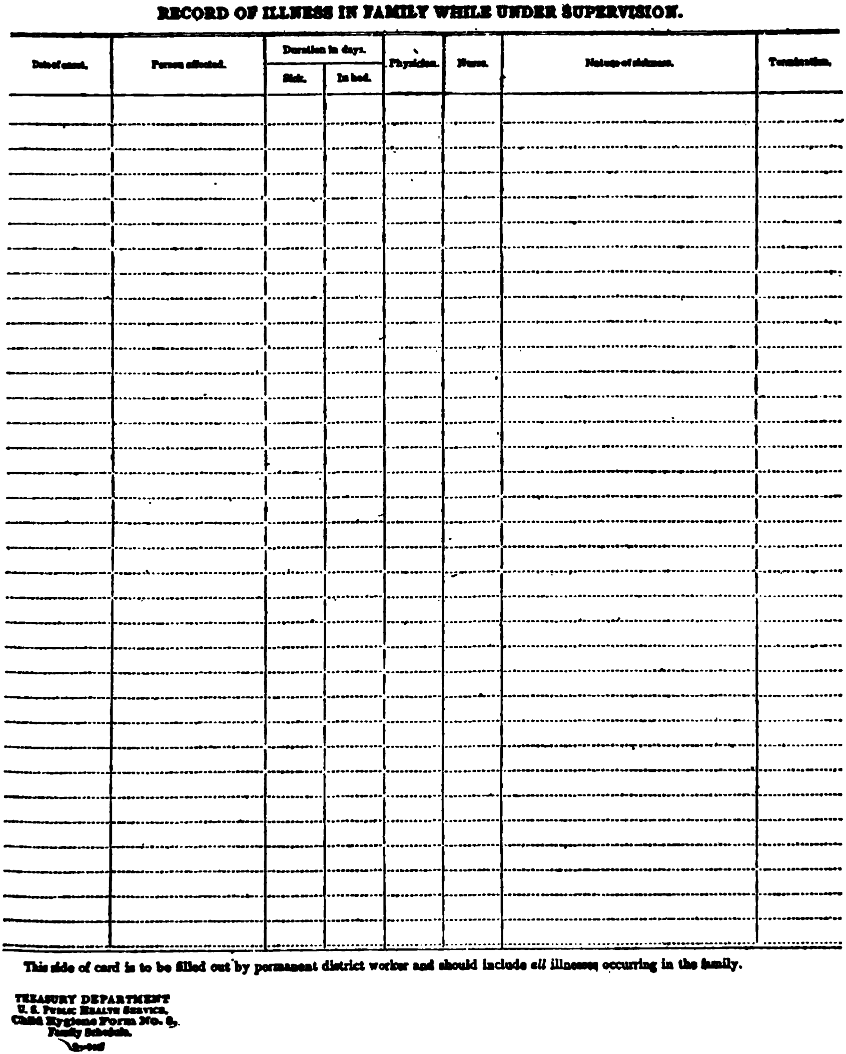
....

Height with (without) shoes at end of session .... inches. Weight with (without) coat or wraps at end of session .... pounds.

Date this record was begun ...., 192....
Date this record was ended ...., 192.... .... *Teacher.*

(THIS SIDE TO BE FILLED OUT BY TEACHER.)

FIG. 15.



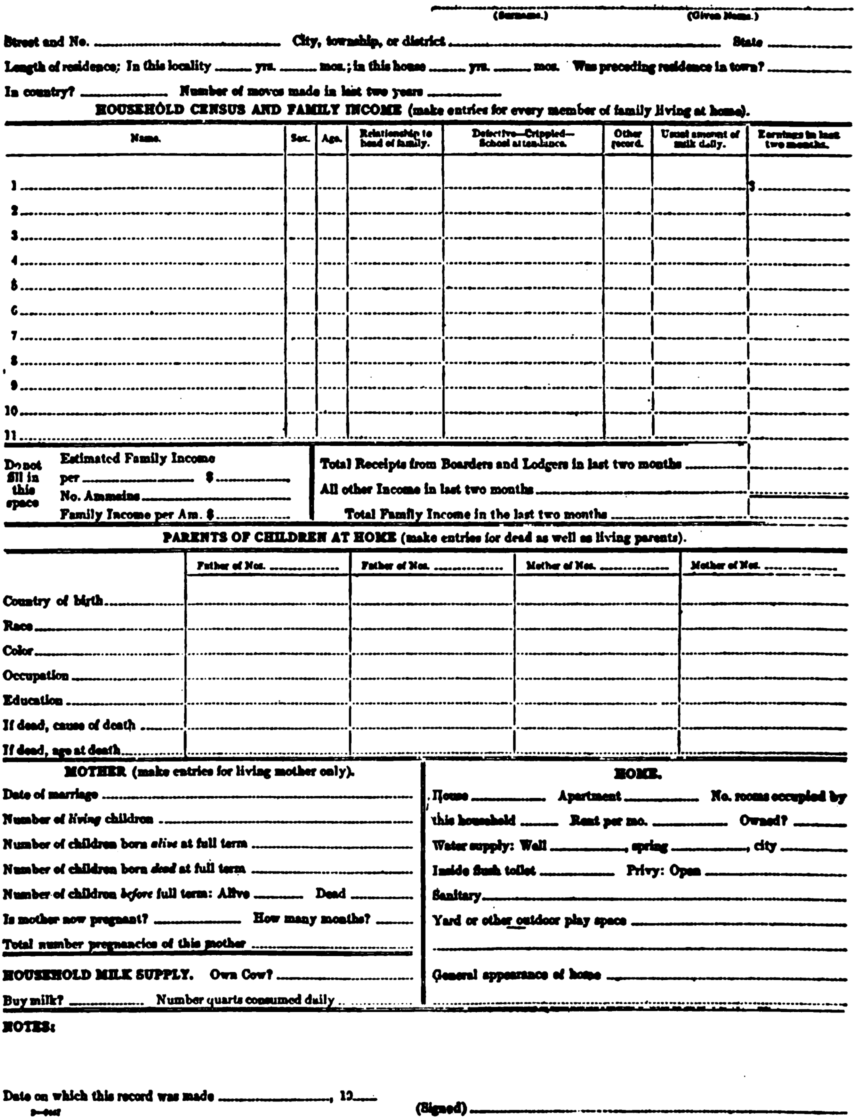
RECORD OF ILLNESS IN FAMILY WHILE UNDER SUPERVISION.

Date of onset.	Person affected.	Duration in days.		Physician.	Nurse.	Nature of sickness.	Termination.
		Sick.	In bed.				

This side of card is to be filled out by permanent district worker and should include *all* illnesses occurring in the family.

TREASURY DEPARTMENT
U. S. PUBLIC HEALTH SERVICE,
Child Hygiene Form No. 6,
Family Schedule.
[illegible]

FIG. 16.



______ (Surname.) ______ (Given Name.)

Street and No. ______ City, township, or district ______ State ______

Length of residence; In this locality ______ yrs. ______ mos.; in this house ______ yrs. ______ mos. Was preceding residence in town? ______

In country? ______ Number of moves made in last two years ______

HOUSEHOLD CENSUS AND FAMILY INCOME (make entries for every member of family living at home).

Name.	Sex.	Age.	Relationship to head of family.	Defective—Crippled—School attendance.	Other record.	Usual amount of milk daily.	Earnings in last two months.
1							$
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							

Do not fill in this space

Estimated Family Income

per ______ $ ______

No. Ammains ______

Family Income per Am. $ ______

Total Receipts from Boarders and Lodgers in last two months ______

All other Income in last two months ______

Total Family Income in the last two months ______

PARENTS OF CHILDREN AT HOME (make entries for dead as well as living parents).

	Father of Nos. ______	Father of Nos. ______	Mother of Nos. ______	Mother of Nos. ______
Country of birth				
Race				
Color				
Occupation				
Education				
If dead, cause of death				
If dead, age at death				

MOTHER (make entries for living mother only).

Date of marriage ______

Number of *living* children ______

Number of children born *alive* at full term ______

Number of children born *dead* at full term ______

Number of children *before* full term: Alive ______ Dead ______

Is mother now pregnant? ______ How many months? ______

Total number pregnancies of this mother ______

HOUSEHOLD MILK SUPPLY. Own Cow? ______

Buy milk? ______ Number quarts consumed daily ______

HOME.

House ______ Apartment ______ No. rooms occupied by this household ______ Rent per mo. ______ Owned? ______

Water supply: Well ______, spring ______, city ______

Inside flush toilet ______ Privy: Open ______

Sanitary ______

Yard or other outdoor play space ______

______

General appearance of home ______

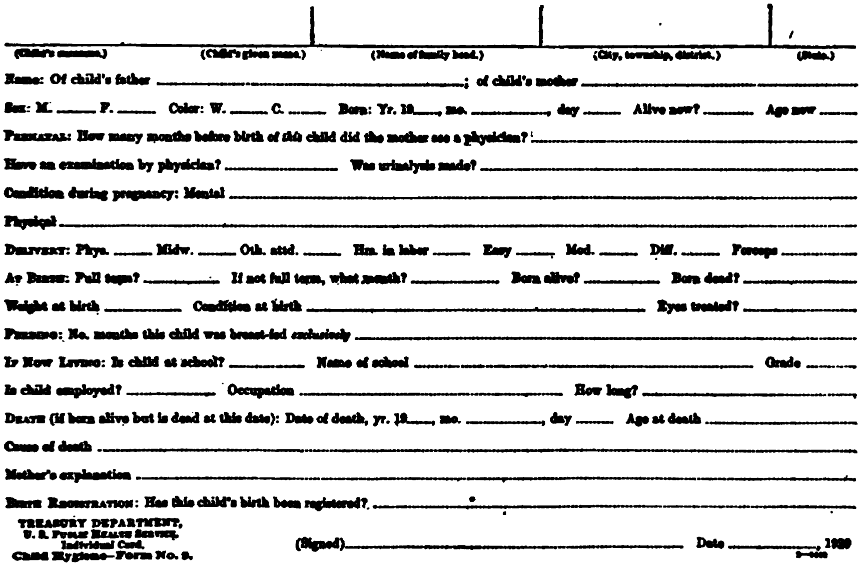
NOTES:

Date on which this record was made ______, 19__

[illegible]

(Signed) ______

FIG. 17.



(Child's surname.) | (Child's given name.) | (Name of family head.) | (City, township, district.) | (State.)

Name: Of child's father ______; of child's mother ______

Sex: M. ______ F. ______ Color: W. ______ C. ______ Born: Yr. 19___, mo. ______, day ______ Alive now? ______ Age now ______

Prenatal: How many months before birth *of this* child did the mother see a physician? ______

Have an examination by physician? ______ Was urinalysis made? ______

Condition during pregnancy: Mental ______

Physical ______

Delivery: Phys. ______ Midw. ______ Oth. attd. ______ Hrs. in labor ______ Easy ______ Mod. ______ Diff. ______ Forceps ______

At Birth: Full term? ______ If not full term, what month? ______ Born alive? ______ Born dead? ______

Weight at birth ______ Condition at birth ______ Eyes treated? ______

Feeding: No. months this child was breast-fed *exclusively* ______

If Now Living: Is child at school? ______ Name of school ______ Grade ______

Is child employed? ______ Occupation ______ How long? ______

Death (if born alive but is dead at this date): Date of death, yr. 19___, mo. ______, day ______ Age at death ______

Cause of death ______

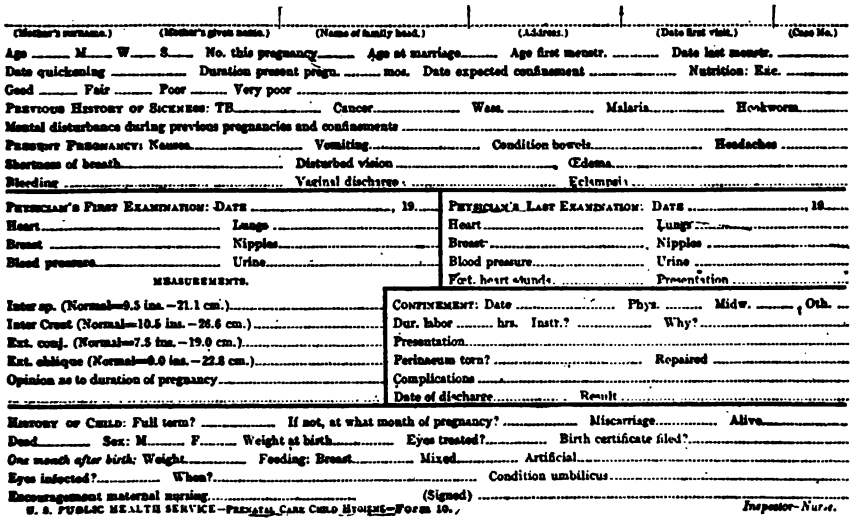
Mother's explanation ______

Birth Registration: Has this child's birth been registered? ______

TREASURY DEPARTMENT,
U. S. PUBLIC HEALTH SERVICE.
Individual Card.
Child Hygiene—Form No. 9.

(Signed) ______ Date ______, 1920

FIG. 18.



(Mother's surname.) | (Mother's given name.) | (Name of family head.) | (Address.) | (Date first visit.) | (Case No.)

Age ______ M.___ W.___ S.___ No. this pregnancy______ Age at marriage______ Age first menstr. ______ Date last menstr. ______

Date quickening ______ Duration present pregn. ______ mos. Date expected confinement ______ Nutrition: Exc. ______

Good ______ Fair ______ Poor ______ Very poor ______

Previous History of Sickness: TB______ Cancer______ Wass. ______ Malaria______ Hookworm______

Mental disturbance during previous pregnancies and confinements ______

Present Pregnancy: Nausea______ Vomiting______ Condition bowels______ Headaches ______

Shortness of breath______ Disturbed vision ______, Œdema______

Bleeding ______ Vaginal discharge ______ Eclampsia ______

Physician's First Examination: Date ______, 19___

Heart______ Lungs ______

Breast ______ Nipples______

Blood pressure______ Urine______

MEASUREMENTS.

Inter sp. (Normal=9.5 ins.–21.1 cm.)______

Inter Crest (Normal=10.5 ins.–26.6 cm.)______

Ext. conj. (Normal=7.5 ins.–19.0 cm.)______

Ext. oblique (Normal=9.0 ins.–22.8 cm.)______

Opinion as to duration of pregnancy______

______

Physician's Last Examination: Date ______, 19___

Heart ______ Lungs ______

Breast ______, Nipples ______

Blood pressure______ Urine ______

Fœt. heart sounds. ______ Presentation ______

Confinement: Date ______ Phys. ______ Midw. ______, Oth. ______

Dur. labor ______ hrs. Instr.? ______ Why? ______

Presentation______

Perinaeum torn? ______ Repaired ______

Complications ______

Date of discharge______ Result ______

History of Child: Full term? ______ If not, at what month of pregnancy? ______ Miscarriage______ Alive______

Dead______ Sex: M______ F______ Weight at birth______ Eyes treated?______ Birth certificate filed?______

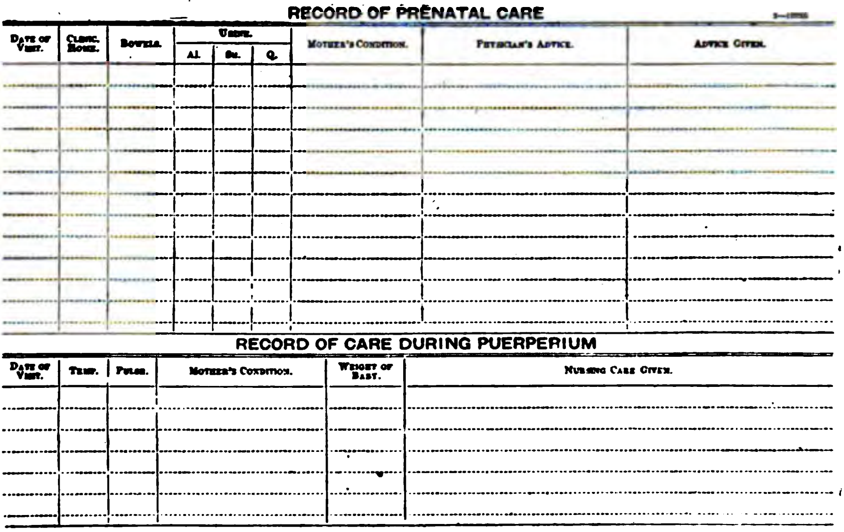
One month after birth: Weight______ Feeding: Breast______ Mixed______ Artificial______

Eyes infected?______ When?______ Condition umbilicus______

Encouragement maternal nursing______ (Signed) ______

U. S. PUBLIC HEALTH SERVICE—PRENATAL CARE CHILD HYGIENE—FORM 10. *Inspector-Nurse.*

FIG. 19.



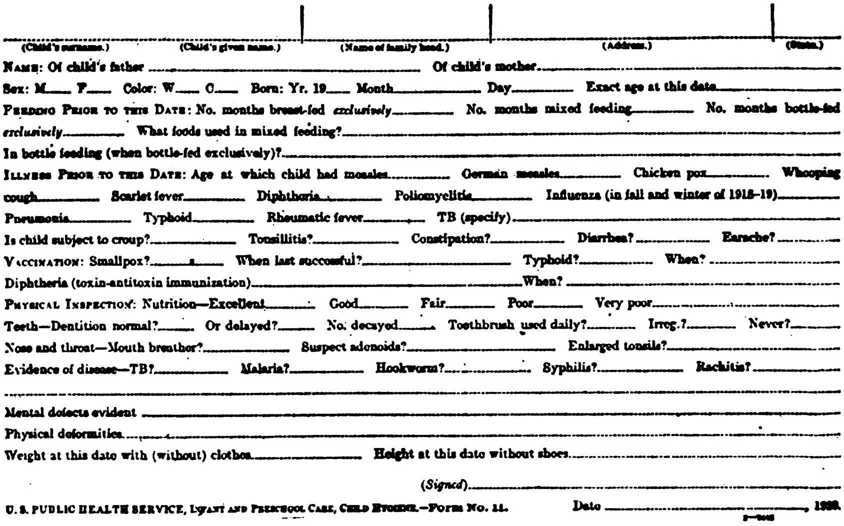
RECORD OF PRENATAL CARE

Date of Visit.	Clinic. Home.	Bowels.	Urine.			Mother's Condition.	Physician's Advice.	Advice Given.
			Al.	Su.	Q.			

RECORD OF CARE DURING PUERPERIUM

Date of Visit.	Temp.	Pulse.	Mother's Condition.	Weight of Baby.	Nursing Care Given.

FIG. 20.



(Child's surname.) (Child's given name.) | (Name of family head.) | (Address.) | (State.)

NAME: Of child's father ________ Of child's mother ________

SEX: M___ F___ Color: W___ C___ Born: Yr. 19___ Month ________ Day ________ Exact age at this date ________

FEEDING PRIOR TO THIS DATE: No. months breast-fed *exclusively* ________ No. months mixed feeding ________ No. months bottle-fed *exclusively* ________ What foods used in mixed feeding? ________

In bottle feeding (when bottle-fed exclusively)? ________

ILLNESS PRIOR TO THIS DATE: Age at which child had measles ________ German measles ________ Chicken pox ________ Whooping cough ________ Scarlet fever ________ Diphtheria ________ Poliomyelitis ________ Influenza (in fall and winter of 1918–19) ________

Pneumonia ________ Typhoid ________ Rheumatic fever ________ TB (specify) ________

Is child subject to croup? ________ Tonsillitis? ________ Constipation? ________ Diarrhea? ________ Earache? ________

VACCINATION: Smallpox? ________ When last successful? ________ Typhoid? ________ When? ________

Diphtheria (toxin-antitoxin immunization) ________ When? ________

PHYSICAL INSPECTION: Nutrition—Excellent ________ Good ________ Fair ________ Poor ________ Very poor ________

Teeth—Dentition normal? ________ Or delayed? ________ No. decayed ________ Toothbrush used daily? ________ Irreg.? ________ Never? ________

Nose and throat—Mouth breather? ________ Suspect adenoids? ________ Enlarged tonsils? ________

Evidence of disease—TB? ________ Malaria? ________ Hookworm? ________ Syphilis? ________ Rachitis? ________

____

Mental defects evident ________

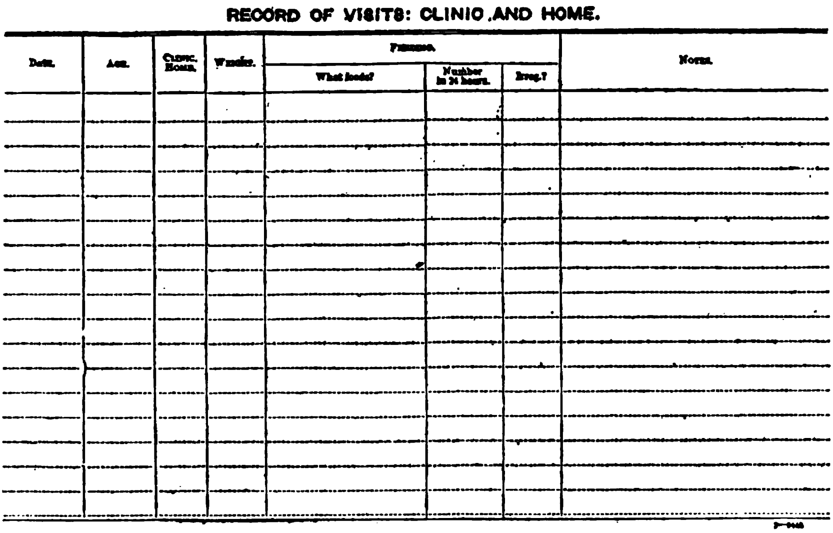
Physical deformities ________

Weight at this date with (without) clothes ________ Height at this date without shoes ________

(*Signed*) ________

U. S. PUBLIC HEALTH SERVICE, INFANT AND PRESCHOOL CARE, CHILD HYGIENE.—Form No. 11. Date ________, 192

FIG. 21.



RECORD OF VISITS: CLINIC AND HOME.

Date.	Age.	Clinic. Home.	Weight.	Feedings.			Notes.
				What foods?	Number in 24 hours.	Irreg.?	

FIG. 22.

When a community signifies the desire to engage in child-hygiene work, a preliminary investigation is made of the community resources, and contact is effected with the official and volunteer agencies of the county to determine the extent to which their active cooperation may be expected. On receipt of a favorable report, a survey party is then sent into this community, which makes a house-to-house visit, using the family schedule card for recording data showing the size of the problem. This card is supplemented by child-hygiene form No. 9 (fig. 18), a card for recording data relating to the individual children of each family who come within the scope of the proposed work.

Objection has been raised to the family schedule card on the ground that such card, in addition to serving its purpose in securing data which will be informative to the health authorities, should also serve to direct the attention of individual investigators to definite lines of inquiry. This card as devised does not answer this latter purpose, a number of the questions which may be found on similar cards in use elsewhere having been intentionally omitted. I am of the opinion that a worker who requires such printed guides to community work is not well qualified for the work in question.

For example: It is of but little interest to a health officer to know whether or not an individual housewife has a bathtub or a washing machine because this is a state of affairs which can not be remedied by him. However, such information as relates to the family income or to the number of crippled children residing in a community is of extreme interest to the health authorities leading to corrective measures.

When the preliminary survey is completed the cards are returned to the State board of health and studied from the standpoint of the form of child hygiene work the community may profitably undertake. Usually in the less populous communities this takes the form of the employment of a public health nurse. Following her appointment she is given a duplicate of these two cards filled out with such information as would be useful to her alone. In other words, with these cards in her possession she knows the social and economic status of all the families in the community, the location of expectant mothers and the number and location of infants and children of preschool age and the children attending school who reside in the community. By this means much time is saved. The permanent worker is also provided with child hygiene Form No. 10 (figs. 19 and 20), for recording data relating to prenatal care and child hygiene form, No. 11 (figs. 21 and 22) for recording data relating to the health of infants and children of preschool age, specimens of which are attached hereto. Furthermore, the permanent worker should be required to record all cases of sickness which occur in the family visited by her in her routine work, a place for which is provided on the reverse of the family schedule card. In fact, I am convinced that the general use of some such device as this by States in which a large number of public health nurses are employed will result in very accurate morbidity reports.

Form No. 4 (figs. 12–13) is designed for use in schools where a school nurse or a school physician, or both nurse and physician may be employed, and Form No. 7 (figs. 14–15) for use in schools where neither nurse nor physician is employed. This latter is intended to be filled out by the teacher in cooperation with the parents. I am quite convinced that the wide use of a card of this character in the schools of the State would make available much valuable information regarding the physical status of the school children of the State, their growth and development and school progress, the prevalence of communicable diseases according to season, and the rôle of the ordinary illness of childhood in causing absences from school. In other words, with this information at hand on a State-wide basis the health officer would be in position to arrive at very accurate averages of the physical development of the children of the State according to sex and one-year age periods. The health officer also would be in position to evaluate in terms of dollars and cents the cost to the State of preventable diseases which cause loss of so much time from school and prevent so many children from taking full advantage of the educational facilities provided by the State.

Finally, I wish to recommend to the local agencies the undertakiug of only such work as the community can carry through. We all know what constitutes the ideal and if it were possible we should like to organize in every community prenatal clinics, baby health centers, child dispensaries, increased facilities for obstetrical care and lying-in attention. However, but few communities, sad to say, are prepared to undertake all of these things at once and a recommendation embracing all of them would, in all probability, be so discouraging from the standpoint of cost as to cause a number of them to decline to undertake any work of this character whatsoever. Indeed, a great deal of good can be done by the simplest of measures. For example, an intelligent worker can do much toward reducing maternal and neonatal mortality by giving tactful and intelligent advice to mothers regarding such things as exercise, rest, diet, use of laxatives, care of the breasts, periodic examinations by the family physicians, preparation of lying-in room and provision of a suitable layette for the expected baby. In the same way an intelligent worker making free contact with nursing mothers can do much to reduce the infant mortality rate by advising mothers to take well babies to the family physician for periodic examinations and advice as to how to keep them well, by instructing them in the care of the baby especially with reference to bathing, sleeping, feeding, clothing. In fact, so much can be accomplished in this manner that I sometimes think we are not justified in recommending to a majority of the communities at first the undertaking of this form of work on a more extensive scale.

(Adjourned to Thursday, May 27, 1920.)

MORNING SESSION, MAY 27, 1920.

DISCUSSION OF CHILD HYGIENE ACTIVITIES OF THE SERVICE.

The second day's session was called to order at 10 o'clock a m., Surg. Gen. Hugh S. Cumming presiding.

Dr. DOWLING. I do not think we should let Dr. Clark's paper go by without discussion. If he had had more time he might have given us some additional information. From the investigation we made in Louisiana, Dr. Clark's suggestions strike me as being most interesting. Unfortunately we have not had proper inspection in all schools up to date, and every time we have tried to get an act passed by the Louisiana Legislature some interests have objected. I don't know how we are going to have this done as it should be done unless some provision is made for it through the health department. I shall take back with me the suggestions of Dr. Clark, his memoranda and literature, with the hope that we may be able to put these suggestions into effect in Louisiana.

Dr. JONES. I would like to inform you of the very generous assistance given by the United States Public Health Service to our State in the time of need. As we all know, this subject of child hygiene has very rapidly aroused public interest, so much so that in our State, at the last session of the legislature, two bills were introduced providing for the establishment of a division of child hygiene within our department of health. Each was passed and approved, on the strength of which we went to our appropriations committee, but failed to secure an adequate appropriation for creating the division. In response to our request to the Public Health Service, they consented to furnish us with sufficient personnel to make an investigation and demonstration in Missouri, in which could be formulated standards for further work, and at the same time to organize a division within our department. The people have taken great interest in the project, particularly the women. I know of no single public movement since the close of the war that has been taken up with so much enthusiasm. Shortly after the work was started in a few communities, numerous requests from other places were received, asking for instructions and assistance, local organizations showing a perfect readiness to take it up and follow it through. I wish to take this occasion to express to the United States Public Health Service our appreciation for this cooperation and if I may refer to rural sanitation a subject of yesterday's discussion, I wish also to state that we are very appreciative for the work of that nature done by the service in our State. The work originally was confined to one county in the lead and zinc mining district. The results obtained therein were so marked that adjoining counties have requested the same assistance, and upon the results obtained, we are able to base our claims to the coming legislature for the much-needed support for public health protection in Missouri. Dr. C. P. Knight of the United States Public Health Service, for your information, will take up more in detail the child hygiene program being followed in Missouri.

Dr. HURTY. I thought it might be well for me to mention here the difficulties we have met in Indiana in our efforts to secure a compulsory medical inspection law. The greatest opposition has come from the chiropractors, patent medicine men, and the Christian Scientists. They are strongly organized against the proposition. The chiropractors are against everything that the regular medical profession is for, and the Christian Scientists are against everything that has the word "medical" in it, and so we get ahead of them to a slight degree by calling the bill "Health supervision bill" instead of "Medical." The word "medical" makes them a little wild, like the red rag to the bull. The health supervision bill, we will call it. We have failed in three legislatures to get a compulsory bill. We now have an optional law permitting any school district to establish medical inspection, but very few do it, even after we call attention to the very great importance of the matter. One little experience with trachoma will illustrate this point: In one county we found in the rural schools inspected, 90 cases of trachoma—all rural; we sent kind letters to the guardians and parents in regard to it, urging them to look after the eyes of the children whom we found infected. This letter was followed up to find out how many parents had attended to their children's eyes. We found that 100 per cent of them had failed. They didn't do it, could not do it, wouldn't do it. I thought I would investigate and find out why. I went with the county health officer visiting the homes where we knew they had trachoma. We knocked at the first door, introduced ourselves, told the good farmer's wife who we were. She listened to us in a stupid way, and when we got through our story we said, "Now, why didn't you attend to Mary's eyes?" She replied, "You doctors have some kind of a game—you want to get our money away from us!" That was the answer—that was the "why."

In another place a woman in a nasal tone (many people in Indiana use their noses to talk through and sing through, and that ought to be broken up) said, "Oh, well, I had them sore eyes when I was little; I outgrowed them; guess she will, too." We have tried hard in the kindest manner possible to get their confidence, but they have notions in their heads that have been put there by the odd cults, such as osteopaths, chiropractors, Christian Scientists, and other mental nondescripts, that the doctors are after their money, and even when I told some of these people that we had provided at the county seat a doctor who would do their work for nothing, provided they would simply say they could not afford to pay for it, and insisted the doctors were not after their money, the reply would be, "Well, they want to get it somehow." So this notion is the great difficulty we have to overcome, and I believe in the end we will find that it will be necessary to force public health into the home by law, just as we now force education. The people would not educate until compelled to. Only a certain number—about 10 per cent—that can think of mankind would do it. The 20 per cent that can think what others think would also educate their children without compulsion, but the 70 per cent that can't think at all wouldn't do anything, and they were compelled to educate. So I believe eventually we will not only have compulsory education and compulsory military service (when we went to war we had to draft an Army, as you know, a voluntary system would not do), but we will have to resort to compulsory health supervision and make people look after their children under penalty. I want to speak again about business men in this connection. Where you seek to secure the aid and help of the business man don't forget that he is a power—he is a force; secure his help in this good work. Indeed, the business man is in the saddle;

he is running things; if you can get him interested things will happen, for the business men bring things about. They have a trick by which they do make things happen. Well, don't forget now, if you appeal to the business men you will get good action out of them if you appeal in the right way. Appeal first to their sordid qualities—their avarice and greed—but not too strongly; don't do any misrepresenting.

The promotion of health is a matter of economy. Our supreme court decided that a child 9 years old killed by the Big Four Railroad was worth $10,000. Life is money, according to the courts, and the practical business men know this. Let us save our children, not only from the railroads but also from other causes. Let us get the money idea before them, but don't forget also to appeal to their sentimental and emotional nature, and you will get farther than by appealing only to their avarice. Arouse the emotional—arouse the sentimental in them by drawing a picture of how much happier the children are who have their defects removed and their health given back. You will succeed better. Don't count out the emotional and sentimental nature of man in public health work.

Dr. BANCROFT. I hesitate to differ from Dr. Hurty, he being one of the senior members of this conference, but I feel that we have had experience in California that would make us radically differ from the doctor when he says that compulsion is the way to get this thing over. I feel that the minute compulsion is mentioned (except so far as we compel one person to make his child safe for the others) we retard things rather than make them progress.

Dr. HURTY. Compulsory education has produced no such results.

Dr. BANCROFT. No; but I believe that compulsory remedying of defects in our children strikes in most Americans a feeling of independent action rather than education. I feel in California at least we have had this fight for about 12 or 15 years, and we have found that it is much better to say to a person, "We will examine your child unless you object"; on the other hand, in case of epidemics or of infectious diseases, we say, "Your child must be examined or must remain at home." We have found the great argument these people have is the fact that *compulsion* is desired, and if we had compulsion actually in effect, I feel sure we would not have the success which we have in school inspection, and we are somewhat advanced in school inspection. I am not familiar with the exact number of cities, but practically every city of any size has medical school inspection. It seems to me that one of the great things we need in order to educate the people to the value of these things is some definite results. For a number of years I have tried to get the nurses and doctors engaged in school inspection to give us some definite results. We have many statements like these; we have examined 10,000 children; and have found 10,000 adenoids; we have removed 5,000 of them. We admit this is of great benefit, but we need some definite statement of results like this: "This child has been remedied of this condition and his weight has been increased, or his scholarship has increased and is normal." I would suggest to Col. Clark that some sort of division in the Bureau of Public Health in Washington be established—not a separate division, but some reception bureau where every person engaged in child hygiene throughout the country could record a definite result on a definite child or definite group of children. Some results of that sort have been obtained in California, and I feel we need every argument not as to the number of examinations made, but as to the absolute results obtained.

Surg. Gen. CUMMING. I am sure we would like to hear from our colleague in Canada.

Dr. SEYMOUR. Inspection of schools is done in different ways in Canada. For a number of years medical inspection of the schools in the city of Toronto was done under the direction of the school board of the city. The question as to whether school inspection should be under the management of the school board or health department of the city was voted upon by the ratepayers, and the vote was very largely in favor of placing the medical inspection of schools under the charge of the city health department. The change for the better has been very marked. The work is now carried on under the direction of physicians of the health department, assisted by public health nurses of the same department.

In the Province of Manitoba districts are formed, and the inspection of schools is under the control of the provincial board of health, with a resident public health nurse in each district. The nurse visits the schools under medical supervision in her district, as well as performs the duties of a district public health nurse. Two-thirds of her salary is paid by the municipality in which she resides and the other third by the Provincial Government. The nurse's work is closely supervised by a lady superintendent of nurses, and all the work done under medical direction. This plan is giving most excellent results, as was shown by the report of Dr. Gordon Bell, chairman of the Manitoba provincial board of health, at the recent meeting of the Dominion council of health. This method appears to be giving much better results than is the case where the medical inspection of schools is done under the direction of the department of education.

I think that inspection of schools is a matter of so great importance that the question should be carefully considered by health authorities, and what may be recognized as the best method be given approval. School inspection should be standardized instead of having localities trying all sorts of experimental methods, such as having nurses examining school children without medical supervision.

As you are aware, we have had in Canada legislation enacted providing for a Federal department. As you may be aware, two years ago we had in Canada legislation enacted providing for the creation of a Dominion department of health. There is in connection therewith the so-called Dominion council of health, which consists of the deputy minister of the department of health, as chairman, a lady representing child-welfare work, a lady representing the women of Canada, a labor representative, a representative of scientific medical research work, and the chief medical officer of each of the Provinces. This council has so far met twice a year and the result of its work is already apparent in the unification of provincial health laws, Dominion collaboration of vital statistics, and other matters.

The scarcity of medical and nursing help created as one of the results of the war, necessitated the establishing of so-called health centers. With the Union Municipal Hospital we are trying to have the required number of physicians and nurses, district nurses to reside in the nurses home with which each hospital is provided, and from this center they help to provide nursing help for the district.

At these small hospitals, which are intended primarily for emergency and maternity cases, we have established a short course of training for nurses in hopes of meeting to some extent the shortage which exists in rural districts. The course consists of 12 months spent in the hospital, and three months at the provincial sanitorium for tuberculosis. After which, if their work has been of a satisfactory nature, and the examination is passed, a certificate entitling them to registration is given. It is our aim to recruit as far as possible for this work young women from the immediate entourage of the hospital, in hopes that when their course is completed they will return to their former homes and help to supply the nursing requirements of the district.

The shortage of medical help in some of the districts of Saskatchewan is very acute. In one particular locality, which is said to have a population of about 2,000 within a radius of 25 miles, it has not been found possible to obtain a medical man to locate there, notwithstanding the offer of a bonus of $125 per month for a year, besides other inducements. The Red Cross is also prepared to help by the establishment of an outpost in that district.

I mention this at this particular time because we would like to have some more of the good men to go there from this side of the line. We have a number of men practicing in the Province of Saskatchewan who are graduates of Northwestern University and other universities, certainly doing good work and we would like to get some more.

The **Surgeon General.** I am almost sorry that I asked Dr. Seymour to talk; I am afraid some of our doctors will be going up to Canada with all these inducements.

Dr. **Harper.** I want to say, Mr. Chairman, that while I do not want to differ with Dr. Hurty I must confess I can not agree with him on the compulsory side of school inspection. We tried to get a compulsory law on several occasions and aroused a large opposition. In 1911 we lost such a bill in the legislature by a tie vote, and the opposition was of such large proportion that we deemed it unwise to reintroduce the bill in successive legislatures. We have not, therefore, a great deal of opposition to school inspection at the present time. There was originated in Wisconsin, by one of our lady physicians, in conjunction with the Children's Bureau at Washington, a program for weighing and measuring of school children. I was in the dark on that. It seemed to me like a great big momentous problem with results that were to be questioned. I remember at the first meeting I asked a good many questions and expressed myself as opposed to the program. I want to say that I have changed my mind. Nearly every child of school age in Wisconsin, especially in the lower grades, has been weighed and measured. While you may not get anything immediately from such procedure, yet the report goes home that the child is underweight and the parents wonder why. This causes them to make inquiry of the family physician, and the family physician examines them and frequently discovers adenoids, affected tonsils, malnutrition of a certain type, or ailments which have not been given proper attention. Almost invariably when the physician examines the individual child and offers remedies for improvement, the parents will accept his advice. There is more competition in our State at the present time between the school children to get up to what is known as the proper standard of weight than in any other line.

If nothing more than the weighing and measuring of children is done in the school, it is a big thing to get into application the remedial measures of correcting deformities when found. When it comes to adenoids and tonsils, I am almost afraid that there won't be a child in the State having their original adenoids and tonsils left. There is nothing compulsory about this. It is simply that there is an element or an undercurrent going on, on the part of the parent, that they want these children brought up to the average standard. We found also that the opposition to physical examination of school children originates, as Dr. Hurty has stated, more from the chiropractors than from anyone else. Christian Science people are now very reasonable on that question, and if you have the right persons to manage the program, Christian Scientists are not going to object. We don't compel the school child to be examined for physical defects.

It is left optional with the parents, and as a result many schools have 100 per cent examination, sometimes 99 per cent, sometimes not more than 95 per cent. We instruct the examining officials to notify the teacher when the examination is to be made and the teacher in return is to notify the parents, inviting them to be present for such examination or, if they will give a written notice that they do not want their child examined, then such child is exempt from an examination. We occasionally have half a dozen notes come in, "I do not want my child examined," and the text of the note is complied with. All of the other children, however, will be examined and the five or six will go on without an examination. This small number will soon feel lonesome and in a short time will have nothing to talk about. This will prompt them to go to their parents and ask, "Why can't we be examined? Charlie was examined. He had enlarged tonsils and now they have been removed." The next time the examiner comes around these children who were exempt at the first examination will say, "Why can't we be examined too?" and practically every time, these children will receive an examination on the second visit of the examiner. They want to get in under cover after all.

They had their own way originally and they feel they can have it again, if they so desire. At the same time they feel they are losing something if they do not comply with the usual program. We have discovered something further. The nurse who goes into the school can handle the people much better than the average medical man, so far as the actual examinations are concerned. In other words, the nurse gets the cooperation of the community, and whether they can be as efficient or not, remains to be seen. On communicable diseases, however, as Dr. Bancroft, of California, had stated, if she suspects a child in the school has a communicable disease, that child must submit to an examination or be sent home and must stay there until he can come back with a certificate from the family physician, saying that there is no communicable disease present. As things are going now, I am most hopeful that we won't need, in our State, compulsory examination of school children. I believe if we have the proper people making the examinations, that outside of the offspring of the chiropractor, we are going to have very little opposition from any source, and if we get 99 per cent peacefully, it is better than to try to get 100 per cent with a whole lot of opposition, because in the end, we get much more cooperation. We have more work than we can do now with the children and people who are willing to come under the public health provisions. Why not give this class of people the advantage of public health activities, and not materially concern ourselves with a few malcontents, who do not appreciate the advantages of such examinations? I would like to say to the Public Health Service that the weighing and measuring proposition is worth a try-out in any locality as it creates a competition in having better health conditions that you can't start any other way.

The SURGEON GENERAL. Any further discussion?

Dr. DILLON. I just wanted to make a suggestion to Dr. Hurty in regard to securing legislation for the physical inspection of school children. So long as the medical profession of Nebraska fathered such a measure so long was it defeated. In 1919 the medical profession from the background guided and directed a measure of that kind, introduced in the legislature by a member from a rural community, fathered by the Federation of Women's Clubs of that State and the State Teachers' Association, and that measure was passed almost without opposition; guided and directed, if you please, from the background by the medical profession, placing the supervision of it under the State department of health, and while it has been in operation only this year we are getting some splendid results from it.

Dr. OLIN. Michigan is having a rather peculiar experience along this line at the present time. We have no compulsory law and we don't want any. About three months ago I notified the women's clubs throughout the State that the Michigan department of health would send out a corps of medical men and nurses to make school inspections in the rural districts. The only stipulation was that this service must be requested by the community. We have now received so many applications that I believe our force will be busy for the next year with these schools on the waiting list. We are taking one county at a time. We give the parents a chance to request that their children be not examined, and then we carefully avoid having anything to do with these children. We term these people "conscientious objectors." The last session of the legislature passed our reorganization bill, and we are now engaged in reorganizing our entire department. One of the clauses of the bill gave the Michigan department of health the power to close all public or nonessential meeting places. "Conscientious objectors" immediately raised a storm of protest.

"You recognize that there are certain classes in your community that should be controlled?" I asked of them.

"Yes," they agreed; "but our churches all have theater seats, or are separated, and we attend to the ventilation. We don't believe in disease or anything that harm can come from; but even so, we provide for all that."

"How do you want to arrange this thing so that the other people can be taken care of?" I questioned.

They replied that they would like to have the law affect all places except churches. To this I agreed, providing we were to decide upon the number of people allowed in the church at any one time. This clause was written in the law. So the Michigan department of health controls all gatherings of any kind, with the exception of church services, and we can restrict the church service attendance. The "conscientious objectors" were gaining their point and we were gaining ours. Consequently, there was no objection to the bill. They did not consider that we might cut down the attendance to the preacher and janitor. With regard to school inspections, no fault is found, because we do not molest the children of the "conscientious objectors." We don't care what their religious belief is or how they treat themselves, providing they do not endanger their neighbors. I want them to thoroughly understand that I am not going to molest them so long as they do not put their neighbors' health in jeopardy. I think that the last session of the legislature was the only session at which members were not flooded with telegrams and letters protesting certain laws. After this first experience with the "conscientious objectors," I called a meeting and told their leader that we had their mailing list; that we knew who their members were; and that we intended to let every legislator receiving protesting telegrams know whether they came from members of this society. Of course that would take away a lot of their influence.

"I do not want to fight," I declared, "and I am not going to molest you. But here is the legislation to put through this session; what are your objections to it?"

In the end, when they simmered it all down, they could not object to much—some inconsequential clause; one or two little changes were made to suit them. We had no trouble. No; I don't want compulsory school inspection, because the word "compulsory" starts a fight right away. The better way is to lead the objectors up to the legislation and put it across before they know what has happened. I think we can go further without the compulsory clause.

Dr. DeVilbiss. It is very gratifying to me to see the interest taken in child hygiene at this meeting and to watch year by year the public-health profession's growing recognition of its importance. If Dr. McLaughlin were not here, I would say that I consider child hygiene the most important of all public-health work, and the keenest entering wedge we have for the entire public-health program.

Perhaps the simplest way of bringing before you the scope of child-hygiene activities is to give a short outline of what we are doing in one State which is just beginning a child-hygiene program—this program begins at the child and will work forward through the preschool and the school-age periods, work out methods for protecting the health of children in industry and for the social pathological group—the crippled, the defective, and the dependent. At the same time the program will work backward to include stimulation of birth registration, the providing of proper obstetrical facilities, and prenatal supervision. To reach the babies, and through them the rest of the family, we are establishing baby health centers. We are using this term to designate what is in effect a Baby Day conducted at regular intervals through the summer or the entire year, as the case may be. Many communities know what a Baby Day is, and those who have conducted them feel the need of a continued period of regular supervision of the babies. So it is easy to ask the community to provide facilities for examining babies at regular intervals by the establishing of a baby health center.

In the State of Georgia, the State Pediatric Society cooperates with the division of child hygiene of the State board of health by the members giving their services to examine babies in the baby health centers and to outline treatment. In rural districts this may serve two purposes at once—the babies are given an examination by a specialist, and the local doctors may have the benefit of the clinic.

This fall we will go into the schools with an extensive height and weight taking and follow-up campaign. When the physician goes into the schoolroom as medical inspector, ordinarily, and tells the mother that her child has infected tonsils she may believe him and she may not. To persuade her to act on his advice is a very uncertain and sometimes difficult matter. But the minute her child is put on the scales and found underweight, she is told something in language that she can understand, and she wants to know how she can remedy it. The correction of the physical condition is now on the other foot. It is now not something which the doctor or the teacher wants done, but it is something which the mother and Johnnie himself feels keenly about. It has been found that if the child is promised that he is likely to gain the coveted number of pounds so that he can rank 100 per cent in weight with the rest of the class, the average child will eat oatmeal, go to bed early nights; in fact he will do almost anything he is told to do. When he fails to gain in weight or to come up to the normal, he will voluntarily consult a doctor and he will eat on the advice given.

In connection with the height and weight taking campaigns do not overlook the assistance which the home demonstration agents can give you. Following the height and weight taking, the next big health problem is the nutrition of school children and babies, and the establishment of nutrition clinics in connection with the schools and the baby health centers. In small towns and rural-school districts we do not have school nurses for home visits, so we bring the mothers with their children to the schoolhouse to meet the home demonstration agent for personal advice in feeding. Very often the local physicians assist by inspecting for the principal defects associated with malnutrition—bad teeth, enlarged or diseased tonsils, faulty posture, soft muscles, and pale color. When giving feeding instructions, the home demonstration agent emphasizes the importance of having physical defects remedied. In other words, she assists in putting physical inspection of school children on a sound basis and in getting physical defects corrected.

With the nutrition clinics well established it is a simple matter to add a school dentist, to organize adenoid and tonsil clinics and, in time, to add one medical service after another. Beginning with the simple baby health center and working along the lines of least resistance, with the parents and the community cooperating every step of the way, it is possible in most communities in the course of four or five years to have established a complete health center in charge of a full-time trained health officer.

Dr. DOWLING. May I suggest that, because of the length of the program, Dr. Clark be asked to close the discussion?

Dr. McCORMACK. Before closing our schedule, I think it is unnecessary to emphasize anything that Dr. DE VILBISS has said, but there is no question that, with a pair of scales in a schoolroom, you can take the scales off parents' eyes quicker than with anything else in the world.

Dr. WEST. Dr. Knight is in charge of the demonstration in Missouri, which, according to my understanding, is one of the biggest things of its sort the State has ever put on, and I do not believe this discussion ought to be closed until Dr. Knight has a few minutes to say something about his work.

Dr. KNIGHT. On entering Missouri, the Public Health Service proposed to carry on field investigations and demonstrations in child hygiene, of which Dr. Clark spoke yesterday.

It proposed to organize for the State a division of child hygiene. It proposed to assist local communities to carry on this work and to stimulate them with the realization that health supervision of their children is a community problem.

In organizing this division of child hygiene, an attempt has been made to coordinate the existing unofficial organizations working, or contemplating work in child hygiene. It was the function of the Missouri Tuberculosis Association to donate funds for publicity, and to detail personnel for field organization. The Red Cross agreed to take care of the public health nursing service relative to child welfare. Benefit from the University of Missouri was obtained in detailing in 14 counties their home demonstration agents who conducted the nutrition clinics in the schools. The Woman's Christian Temperance

Union, looking forward to newer activities, agreed to furnish expectant mothers with maternity outfits and comfort kits to all who needed them.

The projects have been the stimulation of birth registration; the carrying on of an intensive school survey; inauguration and establishment of health centers; State-wide publicity, including distribution of literature and delivering of lectures throughout the State.

It is a little early to try to give results, but if you will permit me, I shall read a slight resumé.

Dr. Knight read the following paper:

To date, 25 towns have had a school survey consisting of height and weight taking, physical examinations with their attendant follow-up work to obtain the correction of physical defects, and nutrition clinics. Approximately 35,000 children have been examined. In 11 towns health centers have been established and equipped and funds appropriated for a permanent community nurse. Four counties were selected as demonstration centers, the staff acting primarily as a full-time county health organization. Each unit consisted of a woman physician trained in public health work and especially child hygiene, two or more public health nurses, nutrition specialists, trained school workers, and field investigators. In these counties the full program has been commenced.

The nutrition clinics have been an especially interesting and helpful feature. Instead of class work, individual mother and child clinics have been tried. The mother of the underweight child is invited to the school. The nutrition worker sits down with the mother and the child and has a confidential talk. The object of having the mother and child is that one serves as a check upon the other and more reliable information is obtained. In individual clinics the mothers will give information and ask questions that they would not do in the presence of other mothers. The details of the child's habits are brought out and the nutrition worker gives written suggestions as to how to improve the child's physical condition. Not only are the habits of eating, sleeping, and exercise discussed, but also the attention is called to the physical defects, for the nutrition worker has the report of the physical condition and can explain to the mother the necessity of having the defects remedied.

The physical examinations have demonstrated to the communities the need of further work. Even the leaders have been surprised at the conditions found. In one community, above the average socially, 48 cases of trachoma were found in a school of 350 children, probably brought in by a few children.

Not enough time has elapsed to tabulate the information obtained on a State-wide basis, but in one average town the following information was obtained by the examination of 2,500 children from the first to the eighth grades:

	Per cent.
Defective teeth	40
Underweight	58
Enlarged tonsils	40
Unclean teeth	29
Defective vision	23
Defective hearing	14

Reexamination of underweights showed:

	Per cent.
Fatigue posture	66
Pale color (clinical evidence)	60
Defective teeth	51
Mouth breathing	30

Data obtained at nutrition clinics:

	Per cent.
Diets not approved	94
Lacking fruit and vegetables	64
Inadequate milk	54
Excessive sugar	36
Excessive meat	42
Coffee drinking	30
Irregular and inadequate sleep	75

One surprising fact brought out is that poor nutrition does not seem to depend upon economic conditions as the largest percentage of underweight in several towns was found in schools in the well-to-do districts. This was accounted for largely by late hours, unbalanced meals, and candy eating between meals.

The work is still in a pioneer stage, more in the nature of an experiment to determine the best methods. In an address before the American Medical Association at New Orleans in April, Admiral W. C. Braisted said he had been unable to find any adequate book for school children for teaching physiology and hygiene. I think he should have gone a step further and said that there has been devised no adequate system of teaching physiology, hygiene, and physical education. I have looked over some books used in Missouri schools and none of them have been written in a style which would appeal to the imagination of the school child in the teaching of this subject.

I have here a rough draft which has not yet had the approval of the service, but I want to give you this outline. It is an outline of daily lessons to be included with the physical examination of the child. There is also an outline for teaching the subjects for the benefit of the teachers. The idea is to obtain the interest and appeal to the imagination of the pupil. I want to take this matter up with Dr. Clark to get his opinion of it. This is for the rural schools particularly and I would like to put this system in effect this fall in teaching the principles of personal hygiene and combine an ideal in this study which will appeal to the child. We, of course, contemplate putting this system in the normal schools for the teachers this summer to learn whether or not this is a practical method of teaching hygiene. We want to place this system in the schools and take it up the first month of school opening in September. It will be our endeavor to cover the course as given. The first month there will be weighing and measuring of each child and finding the average weight; discussions on undernourishment and food values; correct method of sleeping, eating, fresh air, etc. The next month there will be testing of vision—lessons on defective eyesight. The following month there will be the examination of teeth, with teaching of oral hygiene and so on until the study is completed.

Dr. C. W. **Goddard**: Pardon me for a few moments. I regret to see this subject pass without calling your attention to work that is being inaugurated by the State board of health of Texas. Last September we organized four new bureaus in the department: Child hygiene, communicable diseases, public health education, and public health nursing. The legislature very kindly gave us a reasonable appropriation for their maintenance. We have at present the bureau of child hygiene fairly well developed, and I appreciate Dr. Knight's report of the constructive work in Missouri. I am also pleased to find that our work is very much in line with the work being done by Dr. Knight in Missouri.

We have in five counties a well-developed county department of health, consisting of a whole-time health officer, a public-health nurse, sanitary inspector, and stenographer. In some of the counties we have more than one nurse; in those counties the department of health handles the work of the child hygiene bureau, and we are establishing health centers, which are controlled by committees composed of representatives from various organizations already existing This work is pretty well developed in five counties, and in part in 32 other counties. In these 32 counties we have only a county department of health, consisting of a part-time health officer, a public-health nurse, and, in a few instances, a sanitary inspector. The same program will be carried out in other counties as rapidly as possible. We are hoping to extend the work over the entire State. We have in the field four representatives who will coordinate their work with the State University in the holding of child-welfare conferences, and who will, following these conferences, establish child health centers and develop the work as outlined. We feel quite encouraged with the work we have been able to accomplish in the past four or five months.

Dr. **Clark**. I referred yesterday to the questionnaire sent to the State health officers. This has been assembled and returned to all the State health officers with the request that they make such corrections as are necessary to bring it up to date. Bear this in mind—just one word as to my conception of what is a mandatory school health law. I think that any school inspection law should be mandatory, in that it demands there should be provided facilities for medical school inspection in cases of contagious diseases, which involve police powers and can be controlled by the State legislature.

Surg. Gen. **Cumming.** It is the general desire that malaria shall be the next subject taken up, with discussion by Dr. Fricks, of the service.

Dr. **McCormack.** As a tribute of the great love and respect we have for Dr. Carter, I suggest that the conference rise.

(The conference rose and greeted with prolonged applause Dr. Carter.)

The **Surgeon General.** We are all glad to hear from Dr. Carter.

Dr. **Carter.** All I can say is, we who have done a long work and are ready to stop, salute you. I have done a long work, and I am very much gratified by your expression of sympathy and commendation.

The **Surgeon General.** We all in the service feel that Dr. Carter is "the father of the service," and practically made modern quarantine, the modern fight against disease, not only in yellow fever but malaria. He led where others followed and perhaps others got a great deal more credit than he.

MALARIA.

(Dr. L. D. Fricks made the following report:)

I have been directed to give you a brief statement of the progress of the cooperative malaria work now being carried on by the Public Health Service, the International Health Board, and the various State health authorities who are interested in the malaria problem. It will be impossible for me to give you the exact figures because of the fact that we are still in the midst of our cooperative campaign, but I will try my best to stick to absolute facts—please note this, Dr. Hayne—and I dare not go far astray, since there are a number of you here who know the status of this work, and will be able to either verify or refuse to accept the statements I make.

This program of cooperative malaria work was begun last year, and was based on work which had previously been conducted in Arkansas and by the Public Health Service in extra cantonment zones. I do not believe that any of us feel that it will be the final solution of our malaria problem by any means, but it will give us a breathing spell and accomplish a great deal at local points, from which we expect to be able to devise means and find ways of extending the work over the entire malaria section of the country. Under this cooperative agreement the malaria control work was to be conducted under the direction of the different State health officials and the supervision of the Public Health Service, with funds secured primarily from local sources supplemented where necessary by the State health department and the International Health Board. In beginning a work of this character on a cooperative basis, it was inevitable that difficulties should be encountered—perhaps some mistakes were made, but we have certainly made considerable progress.

One of the principal difficulties encountered has been in keeping the sanitary engineers originally employed in making malaria surveys and preparing estimates of cost for malaria control demonstrations. Commercial concerns were able to offer them very much better pay than the Government could afford and therefore we have had many changes in our personnel since the work began. Also some difficulty was encountered in arranging for the financing of these malaria control demonstrations. In many places the local authorities were able and glad to furnish the entire amount of funds required and in these cases no delay occurred, but where arrangements had to be made for outside assistance some delay was perhaps inevitable. These appear to me to have been the two main problems which we had to meet in inaugurating this widespread cooperative program for malaria control in 11 different States; and when it is considered that the undertaking is unusual in its arrangement and involves the cooperation of different agencies, I think we may well feel some pride in the progress which has been made up to the present time. I will give you a brief review, however, of the outline of the work and its progress up to the present time in each State, in order that you may judge of its importance and success for yourself.

In undertaking the cooperative program for malaria control one or more sanitary engineers were assigned to duty with each State health officer in 11 of the malarious States. It was expected that the State health officer would select various towns within his State in which malaria surveys would be made by the sanitary engineers, estimates of cost of malaria control prepared, local sentiment for the work sounded, and where conditions were found favorable for selection, the sanitary engineer would assume supervision of antimalaria construction work. Under this arrangement the following operations were conducted:

State.	Sanitary engineer.	Towns surveyed.	Towns selected.	State.	Sanitary engineer.	Towns surveyed.	Town selected.
Alabama	2	22	7	North Carolina	1	9	3
Arkansas	2	8	4	South Carolina	2	5	3
Florida	1	5	1	Tennessee	1	9	2
Georgia	2	14	3	Texas	3	31	12
Louisiana	2	7	3	Virginia	2	6	2
Mississippi	2	17	5				

In making selection of the various localities in which malaria control measures should be conducted, it was suggested to the State health authorities that they favor those communities in which mosquito-malaria control would be feasible at a reasonable cost and in which the community sentiment was strongly favorable to the work and therefore would probably insist upon its continuance in the future. I feel that this was a very wise basis for selection although in reality it is not a question of how much it costs to get rid of malaria, but rather of the returns which the community receives from the money expended for this purpose. That is, if the per capita cost for malaria is great the community can well afford to spend a much larger amount for its control than if the malaria cost is small. The per capita cost as estimated for malaria control in the above communities is slightly over $1. Effort was made to secure uniformity in cost for different towns selected in order that more just comparisons might be made in results accomplished for small expenditures.

This I believe is a fairly comprehensive outline of the cooperative program for malaria control which is now under way. We have attempted in every way to carry out the program in the spirit in which the different cooperating health agencies entered into it, thus giving all possible assistance to the State health authorities in carrying out this work which we consider their own. In no way has the program been altered except that an ichthyologist from the Bureau of Fisheries has been detailed to advise and assist us in making use of fish as a means of mosquito control, thus supplementing drainage operations and in certain places materially reducing the cost. In one place, Athens, Tex., we have attempted to control mosquito production entirely by the use of fish. One difficulty which we have encountered, and which is probably worthy of your attention, is the absolute necessity in initiating this work of showing the people immediate and definite results. At Baton Rouge, La., where an excellent piece of work had been conducted insofar as malaria control was concerned, the people were not satisfied with the work because mosquito production inside the city was not placed under thorough control. On the other hand, we found in Dothan, southeast Alabama, where the people were at first decidedly uninterested in the work, that after draining a swamp which extended up into the outskirts of the town, and thereby killing, according to the sanitary engineer in charge, two wagon loads of snakes, the people were delighted and gave the work their hearty support. The securing of the interest and support of the local communities for this work is fundamental, because it will profit us nothing to carry it on for a season and then have it fail for lack of local support.

Our hope in undertaking this work is that it will be extended from these areas and be enlarged upon and ultimately will reach the rural districts where, as we all know, the real malaria problem of the South is to be found. I think, myself, that there is no question but that during the next season and in the years to come, the State health officers will have requests from more towns for malaria-control demonstrations than can be handled under the present program, but I do not feel that even when all the urban communities of the South have been reached the malaria problem will be solved. We all know that malaria is a rural problem. We may have some differences of opinion as to just what relation it bears to the health of the entire United States; personally I feel that it is a local health problem, but one of such extent that its economic importance affects the entire Nation. Dr. H. R. Carter and Dr. L. O. Howard, who have studied the malaria problem in the United States longest, have estimated the economic losses from malaria and are able perhaps to give us an approximate idea as to their extent, but I think the best the majority of us can do is to wildly guess it. We say, "perhaps a billion dollars," but we know very little about the extent of malaria in the South; there are no exact records showing its prevalence in any State. We do know that there is no danger of the spread of malaria from south Georgia to north Georgia, from west Tennessee to the mountains of east Tennessee under present conditions. As a matter of fact, one of the State legislatures absolutely refused to appropriate money for malaria control because it would benefit only one section of the State.

With such conditions confronting us it seems to me that the problem of malaria control is a local health problem. I believe that the States of the South are entitled to all the assistance they can get from the Government and from commercial interests in working out this problem because of the enormous economic importance of malaria to the entire United States and its business interests. In the South we have an area of 400,000 square miles, capable of feeding and clothing the entire United States, which is handicapped, we may say burdened, with malaria. The people of this area are entitled to relief, but I believe that this relief should be offered by and through the State health authorities. They must build up in some way local health units capable of handling their own malaria problems. The general impression has gone out that malaria control can best be effected by some outside agency. This impression is perhaps based on the fact that malaria control in the Tropics has heretofore been conducted in this manner; for instance, by the United States Government on the Isthmian Canal and by the British Government in the East Indies; but in the southern United States we have an entirely different governmental problem, for although we have a large Negro population in the South (at least one-half or more in some States), yet the white man is responsible for local government, and ultimately the responsibility for the solution of the malaria problem of the South will rest upon him and his local government.

It appears to me that the different State health authorities who are most vitally interested in malaria have not at the present time adequate bureaus or divisions and personnel within their health departments for handling the malaria problem. We have few accurate records of malaria from any State in the South, and I feel that before we can go out into the rural communities and undertake malaria control we must have these records. We must know where malaria is. Probably we will find when we begin our attack on the border-line areas, where malaria is not so uniformly prevalent, that a very small and well-directed effort will result in complete eradication there.

Surg. Gen. CUMMING. It has been suggested by a good many gentlemen that in view of the number of papers the remarks be limited to five minutes.

Dr. McCORMACK. I suggest that Dr. Carter be given as much time as he likes, and then the time be limited to five minutes.

Dr. CARTER. In the first place I agree with Dr. Fricks that malaria control is primarily a local problem. I had a long talk with old Sir Timothy Wilcox about three years ago on the drainage in Mesopotamia; he was in control in Tiflis at that time and he greatly blamed us in America for not taking up the matter as it was done by the old Babylonians and Abyssinian monarchs; that is, by putting all the improvements for the land on the land itself. That we can not do; but it is fair that the States that have malaria should bear the expense of eliminating it. What we are doing, however, with the assistance of the International Health Board, is simply pioneer work, demonstration work, to show how malaria can be controlled and the cost of controlling it. I think it is perfectly fair and safe to say that where the work has been done hitherto the percentage on the investment has been from 500 to 1,000 per cent, and if that can be generally believed in the malaria sections, it will in time be generally applied. I would think shame of myself to spend a dollar in malaria control if I did not expect to get $5 back on it. If you remember, some years ago, one of our American sanitarians attempted to evaluate what was received per unit of expenditure in the different methods of sanitation. He did not have malaria on his list; he was a northern man working in northern countries, but, frankly, for hookworm and malaria you get a bigger result per unit of expenditure than in any other method of sanitation I know of. It means, of course, that where the thing seriously prevails it is a long problem. No one need think that malaria is easily controlled or easily gotten rid of; it is cheaply controlled and cheaply gotten rid of if you count the benefits received, but, absolutely, it is neither cheap nor easy. These demonstrations with 5, 10, or 20 to the State where malaria is controlled should go on to 100 times that number until the thing is wiped out, but it will not be in my generation. Malaria controlled in one place in the country leads to better farming and more money; that leads to extension of malaria control, which leads to better farming and more money and you make an endless chain for good in social and pecuniary conditions. Improved health makes improved conditions. In Dr. Rankin's State, since I first knew it, the improvement has been fully 1,000 per cent in malaria. It has been brought about by better crop methods and better malaria control, etc. I look for the elimination of malaria as the result of improved living and agricultural conditions, and by demonstrations showing how to control malaria.

Dr. Bancroft. In California we have been forced to help ourselves; and two years ago there was enacted a mosquito abatement law by which communities might join together and, taxing themselves, form a malaria abatement district. This was found to be very effective in the rich districts, but in the districts which needed it most sufficient funds were not obtained, so it is proposed to request the State to pass a law allowing funds to be given to counties which need it, and there is every hope that this will pass at the next legislature. There is one community which had a malaria rate of 2,487 per 100,000 as told by a careful survey, and in this community $10,000 was spent in 1915. At that time the people in this community were absolutely discouraged; pretty nearly everyone in it had malaria and people could not be induced to come into the district at all. I might say the problem there was introduced by the extension of irrigation. This $10,000 was spent and the community has changed entirely from one where the people were absolutely discouraged to a very live community, and they are the most enthusiastic boosters for the remainder of the State. In this community they have estimated that from the standpoint of real estate transactions there is five times the improvement now over that time, and from the economic viewpoint a great improvement has taken place. Another problem that is rather peculiar in California is that there has been a great extension in the area planted to rice, and the United States Public Health Service has an officer there, Dr. Purdy, who found that the Anopheles mosquito does not breed in our rice swamps. No reason as yet has been found for that rather peculiar condition which differs from most parts of the country. We feel that in California we have a very hopeful outlook. We feel that the only way to get rid of malaria is through oiling and drainage.

Dr. Dowling. At Montgomery, Ala., on the 26th of April, it was my pleasure to meet with the committee on malaria control and education when we discussed the best methods for the control of malaria in the South. Drs. Abercrombie and Welch and one member of the South Carolina development organization were present.

During the day we met with the Southern Settlement and Development Organization, which has its headquarters in Baltimore, Md., and they made the frank and surprising statement (most gratifying to me) that they could not bring desirable immigrants into the South until they could tell the truth and they could not do this "until the South cleaned up." I quoted a paragraph from Dr. Carter's letter in which he stated that if we would provide for the eradication of malaria by getting rid of the Anopheles mosquito and also provide for the proper disposal of human excreta, the South would have no greater health problem than that of any other section of the Union. From information at hand, malaria costs in the Southern States from $3.88 to more than $16 per acre, the latter in the extreme Southern States. I am sure, if properly presented to the farmers and legislators (even though we should need Dr. Hayne, of South Carolina, and some of his statisticians to help us with the figures) they would agree that the eradication of malaria would be a good financial proposition. Louisiana, I am glad to tell you, has the approval of the governor for progress in health work; he has ordered the health bill rewritten and we expect to have a department for the control of malaria in the State. At a meeting in the city some time ago I made the statement when Dr. Fricks happened to be present, that all Southern States in which malaria prevailed should have a department of malaria control. We hope for it in fact very soon.

Dr. Rankin. The most important thing in this local malarial work is the initial survey, that is, the establishment of the base line of endemic infection. We selected with the Public Health Service four communities in North Carolina in which to do this work. We went to the doctors and to the women's clubs of these communities and asked them for an estimate of the malaria. The women appointed a committee and went from house to house with the cards we provided them, and as a result of their survey in these four towns reported a malaria incidence of from 18 to 21 per cent. Now, the great pity is that we did not accept the facts as stated by the doctors and the citizens of the town and go ahead with our malaria reduction work, because if we had done that, if we had not eliminated a single case of malaria we would have had something very greatly to our credit, but we decided first to check up the local survey, the doctors' statements and the women's statements; we sent a doctor and a sanitary inspector into one of these towns. They took the same cards the women used and took one-fourth of the homes and they found from 2 to 3 per cent infections. You see what a tremendous reduction we would have had if we had accepted the statements of their own people, and placed ourselves in the classification given statisticians by Dr. Hayne, of South Carolina.

I mention this because this whole malaria question rests upon an accurate preliminary survey. The doctors said that in these towns from 20 to 60 per cent of their practice was malaria; think what that means. The average doctor has about 250 calls a month or 3,000 calls per year; suppose he has 50 per cent of his calls malaria—1,500 per year—20 per cent would be 600 calls for malaria. A novel idea, coupled with a little enthusiasm, makes the biggest liar in the world. You should establish your base line in this malarial work so that no one can dispute it. I don't want to discourage this proposition; it is one of the most important things we can undertake in the South, but I do think it is important to establish your base line and not to accept the statements of enthusiastic citizens and doctors. The result of our survey was that we went back to these towns and said: "We found conditions very different. Your women told us you had 20 per cent malaria; your doctors said you had more, but we found 2 to 3 per cent. We give you an opportunity to withdraw your appropriations if you wish; we don't want to fool you." Three out of the four towns stayed in on the basis of the 3 per cent infection.

Dr. WELCH. My experience with the Alabama towns was different from that of my distinguished friend from North Carolina. Our citizens are more patriotic than that. They tried to suppress the fact that they have infections of any description, and I had great difficulty in convincing the appropriating powers that they had any malaria at all; I had to prove it to them before I could get any action. That was not hard to do in the towns we finally selected. We had to make 22 surveys before we could find towns where we could go to the appropriating powers and say, "Here you have malaria," and here we did not have any trouble in getting the appropriation. We sent an engineer and let him take the incidence of the town. We had a State engineer of our own, who helped supervise that work. The work in Alabama has been confined to the small towns. Our survey does not indicate the real malaria incidence of Alabama. The main incidence, strictly speaking, is in the rural districts, not in the rural towns. The towns are drained, more or less, and, where there is malaria in the towns, it is in the outskirts, not in the best residence portion of the town. The difficulties we now encounter are getting out in the real malaria nests and cleaning up the rural districts. This is a very expensive proposition and one that demands more attention as the years go by. The main problems we have to deal with in Alabama are malaria and hookworm. If we had these thoroughly under control, I imagine we would have the healthiest State in the country and the most desirable to live in. We can give you any sort of climate down there, all sorts of soil, all sorts of people, and, incidentally, all sorts of health, since we have malaria, typhoid, and hookworm. Dr. Dowling, in his allusion to the meeting in Montgomery, did not touch upon the possibilities of that organization, the farmer's settlement and development agency which is now doing work all over the Southern States. If we can get an organization of that kind to help us, as they seem so anxious to do in all of our Southern States, I think our rural problem will then be solved.

Dr. **Goddard.** In reference to getting the facts for the initial survey, I have found the best plan to send a member of my staff, with the engineer so kindly furnished by the Public Health Service, into these towns and have him assist in making the surveys. Upon entering the town, we notify the chamber of commerce, business men's league, mayor, or whatever body is interested, that we want the real facts existing. They in turn sometimes advise us that while they are aware of the fact that malaria exists in their town or community, they do not want that fact advertised to the world. We very readily arrange for a mutual understanding in order to ascertain the exact facts and give those facts very little publicity. This course has been pursued very satisfactorily, and the commercial clubs and business men and the doctors have cooperated with us and we have no difficulty in getting the real facts in our initial survey in these towns.

One other point that I may mention is that we find that some of the larger corporations are especially interested in malaria control. For instance, the Cotton Belt Railroad is doing some splendid malarial work themselves, and other large corporations have indicated a willingness to cooperate with us. We are inviting these outside forces to assist us in this malarial control work in cooperation with our plan with the people and the Public Health Service.

Dr. **Hayne.** Representing Illinois, New York, Kentucky, Mississippi, and South Carolina, I wish to report that we are doing excellent work in those States, and we do not wish to report in detail that work, because we might discourage those who have reported.

Dr. **Dowling.** May I ask Dr. Ferrell to discuss this subject, and then pass on to rural sanitation?

Dr. **Ferrell.** There is very little that I can add to the account of the work which has already been presented. The relatively large malaria program now under way involves the coordinated activities of the Federal Health Service, the State health organizations, and the local communities. As many of you know, the organization of a piece of work in which a number of different agencies are involved is, at the outset, an extremely difficult task. It so happens in some instances that when the Federal service has funds ready for a certain piece of work, the State is without funds, or perhaps, if the State has money, the Federal Government has exhausted its resources for the particular undertaking. It seems to me, therefore, in view of the difficulty of securing the cooperation of these agencies in a common cause, that most admirable progress has been made in the organization of antimalaria work. I think that the officers, both Federal and State, who have had this work in charge have true cause for gratification with present developments. The demonstrations of this year, I am convinced, are going to make an appeal to the legislative bodies, and I believe that we should now begin to look forward to the future expansion of the work along sound lines. An excellent start has been made and it now remains to select the towns to which control measures are to be extended during 1921 and subsequent years, and to secure Federal, State, and local appropriations for the work.

Doubtless a number of you know that the Public Health Service, after it had made arrangements for cooperating with the States in malaria work, lost a part of its appropriation. I would recommend that health officers throughout the country, and particularly those of the southern States where malaria is one of the most important problems, cooperate with the Federal service in an endeavor to have the original appropriation restored, and if possible increased, so that the Public Health Service may be enabled to participate on a larger scale in the work of malaria control.

Now, as to State and local appropriations: I believe that the psychological time to arouse the local communities to an interest in malaria control is the summer season, when the mosquito is prevalent and chills and fever are rife among the people. Effort properly directed at this time should stir the people to an enthusiasm for town participation in control measures and should lead them to demand from their legislatures the cooperation of the State in this work. If State-wide enthusiasm is to be created, however, a larger number of men should be assigned for demonstration work, so that instead of surveys in seven or eight towns, 50 surveys might be undertaken at this crucial time when malaria is harassing the people and keeping them from work.

RURAL SANITATION.

Dr. CUMMING. If it meets with your approval, it has been suggested that we take up the matter of rural sanitation.

(Dr. Rankin made the following report:)

I want to discuss three points: First, the desirability, if not the necessity, of a standard in public health work; second, the difficulty of using present standards; third, the possibility of improving standards for measuring the value of public health service. The whole public health proposition is one of salesmanship. When one gets right down to a legislature or board of managers and proposes a piece of work for which they are to pay so much money and for which certain values should be returned, one must have, as nearly as possible, an exact standard for measuring the value of the public health work which follows the investment. When I say a standard, I mean not one that suits a public health officer, but one that people themselves, the court of public opinion, will approve. We started out a few years ago with a standard of whole-time health departments in the county. Then a few years ago, we recognized that we might get a whole-time health department in the county that didn't amount to anything, that it could not be used, and some of the counties doing health work had their work planned on the unit system; that is, each independent health problem was regarded as a unit, and in 8 or 10 counties a standard plan of work was adopted, so that by taking the average of those counties we had a basis of comparison for the work in all counties. That has been the method that has been followed in my own State for three years, the unit system.

It has recently developed that the unit system will not do for this reason: Units are temporary. You go into a county, you put in your sanitary privies, and that unit is finished, and you can not compare the work in that county where the privy unit is finished with a new county, where the privy unit is in operation. You may have one county with a $10,000 budget, working on five or six units; another county with $2,000 working on two units. You can not make comparisons. You may have one county with 60,000 people and one with 6,000, so you can readily see that the unit standard plan of work is defective. We have followed the custom of calling in our local health officers once a year and letting them sit down around a table and pool all the experience they have gained in the past year and incorporating all their newer ideas in a revised standard plan.

At our last meeting in January this thing came up: The health officer working in a county where there were 400 county dependents (inmates of jails, county homes, county camps, and a county sanitarium) said to me, "I don't get any more credit for taking care of these 400 dependents than the average county gets for taking care of 50 dependents; how are you going to adjust that matter?" One way that suggested itself was to determine a reasonable per capita cost for taking care of county dependents. Supposing we fixed that at 25 cents per month, or $3 per year, then we would give the health officer a credit of $1,200 for taking care of 400 dependents, whereas the man with only 50 would be credited with $150. Our standard would consist in reducing each item of health work to a reasonable financial equivalent.

The possibility of establishing a financial equivalent for every single unit and item of health work seemed not altogether an impossible task inasmuch as that has already been done in a great many instances, as for example, in North Carolina (pardon me for referring to my own experience) we have, in the last three years, innoculated about 200,000 people against typhoid fever. Last year the cost was about 25 cents and this year about 30 cents for complete vaccination. We know about what a reasonable cost for vaccinating people is. Also we can establish a financial equivalent for vaccinating people against smallpox, which is one of the items of county health work. Dr. Fiske, of the Life Extension Institute, of New York, knows approximately what it has cost the Institute for about 200,000 periodic examinations—about $2.50 for each examination. Looking into the question of the cost of venereal disease dispensaries, I found that last year in the dispensaries in North Carolina, the cost varied from less than 50 cents for treatment to $3, the average cost being about $1.75. Our contract with the cities and towns in North Carolina next year for the continuance of the venereal disease dispensaries will be based upon a financial equivalent. Some of these dispensaries have treated from eight to nine persons per month. We have spent $150 to $200 per month for eight or nine people treated, and we are not going to waste money like that any more. The money we pay for treatment of venereal diseases after July 1 will be paid for work done. We will say further to all the counties that have vaccinated their people, here is the financial equivalent for vaccinating, say, 30 cents or 40 cents; we will pay 20 cents for each complete vaccination. You must keep a card index of the names and addresses of the persons vaccinated against smallpox and typhoid fever, and we will send you a check every six months for such vaccinations.

I believe that it is possible to establish a financial equivalent for every piece of health work. There should be a financial equivalent for educational work. I don't know what that financial equivalent should be. Let us assume that it is worth 10 cents per capita for every person that the county health officer addresses with an illustrated lecture. He goes out and speaks in a school house; he is able to show that there were 85 people in the audience. The financial equivalent is $8.50 for that lecture. Going back to the question of establishing financial equivalents, a financial equivalent for all matters published in newspapers can be established. I don't know any single item of health work for which a financial equivalent can not be established. We propose to get all the data we can bearing upon every item of local health work. We are going to ask the governor to appoint a committee of business men to determine the financial equivalent. Then we are going to give that body all the evidence bearing on the reasonable cost for vaccinating against typhoid fever and reasonable cost for vaccinating against smallpox, and for periodical examinations for building privies, etc. On a basis of financial equivalents we shall pay for work and not for offices and salaries.

Dr. HAYNE. Dr. Rankin has very logically presented his subject. I remember, about two years ago, certain gentlemen representing certain groups of States got together in the Washington Hotel in this city, and presented an extremely logical appeal, as they thought. This was presented to a very high official in the Federal Government, and this was his remark upon reading it: "I can not detect your lack of logic, but do not think that your conclusions are properly deduced from your major premises." Dr. Rankin assumes that the only value of public health is the tangible results of people vaccinated, privies built, etc. John the Baptist—and I take John because I do not care to be sacrilegious—the results of John's work were poverty, dwelling in a desert, and finally having his head taken off and offered to Salome on a salver. Henry Ward Beecher followed in the steps of John, and what were his rewards? Wealth, a wealthy church, and a very large congregation, but the seeds that were sown by John the Baptist have been reaped by the Christian church.

A man goes out into a county and his personality and his talks and his personal association with the people of that county bear fruit later on, and it would be impossible to tell what was the value of that man's work in a county by counting up the number of privies that he built, or the number of people vaccinated. To turn over to business men, of all men, the valuation of health work seems to me the most absurd deduction. I do not believe, and cannot believe, that the work of Metchnikoff, or of Marie, or of Pasteur would have been evaluated by the business men of Paris as of any great substantial value in the world, and we know that these men died poor.

Practically, I can not see how I could offer to pay a health officer according to the premises laid down by Dr. Rankin. We have lying enough as it is, and I don't propose to put an absolute premium upon it. If a man's salary is to depend upon how many people he has vaccinated, how many privies he may have renewed, improved, etc., it would take a very large force to check him to see if he has done that, and that would increase the overhead costs. Dr. Rankin says he gets his vaccination for 30 cents, and we know the cost of typhoid vaccine from the manufacturer is 30 cents; he probably manufactures his own typhoid vaccine, but, after he kills a couple of children, as we did in South Carolina, he will probably have some manufacturer take up that end of the work.

Dr. **Rankin**. I don't believe South Carolina killed those two children, for the reason Dr. Hayne swore that the State did not do it. The first thing is placing the whole question of public health on a humanitarian value, that is not denied; but the fact is that even down in South Carolina they do place a financial equivalent on health work; they do fix the salary of the county health officers and of their assistants; the only difference between Dr. Hayne and myself is the method of establishing this equivalent. The second thing is the question of records and the like. When a health officer says that he has built 833 privies in a year, there should be 833 cards in a card index system. It would take 5 or 10 seconds to make out each card, and we do not accept his statement that he has built 833 privies. The supervisor goes there and asks him for the card index. He picks out the cards and the statement is accepted by what the officer finds and not by what the health officer says. Everything is card indexed. If he says he has vaccinated 3,300 persons against typhoid fever, he must have the names and addresses or his statement would not go.

Dr. **Williams**. I hope Dr. Rankin will not get discouraged in trying out these various equivalents. We health officers see a great many difficulties in the way of it. Certainly, if we have some way of establishing a standard measure for work, we ought to do it. Yesterday our great exponent of rural sanitation in one of his discussions, instead of using the term "rural sanitation," spoke of "rural health work." I hope in the future we will abandon the term "rural sanitation," and when we speak of health work in country districts we will speak of rural health work.

The term "rural sanitation" was, I believe, coined in the South, when we began the campaign against hookworm disease, and the big problem in the hookworm campaign was the problem of sanitation, and the term "rural sanitation" has continued as this work has developed. In speaking of the health work, I am reminded of an analogy which, I think, Dr. Hayne very appropriately mentioned in one of his talks: Some blind men were brought to the side of an elephant; the blind men wanted to know what an elephant looked like. One man caught hold of the elephant's leg, another felt of his side; one caught hold of the tail, one caught hold of his ear, and another his tusks; each of them was impressed with a very different idea of the elephant, according to the part that he felt.

Health work is our elephant, and health officers see the work according to the part that they are next to. The hookworm worker and those of us working in the South see the problems of excreta disposal. Some see malaria as a great health work; others see child hygiene as a great health problem. The venereal disease physician says that he has the great problem, and so on. These are all essential departments of health work. Every one has his own separate problem. We in the South see malaria, and the filth borne or excreta born diseases are our great problems—the greatest that we have. Those farther north, Kansas, Ohio, and New York, do not have those problems at all. They discuss child hygiene and other things.

Up in Saskatchewan, it seems to be the establishment of hospitals. They are going into relief work. It would be wrong if we in the South should go into the establishment of hospitals and look after child hygiene and some of the other things, when we have a limited amount of money to spend. We must consider our mortality returns and our morbidity returns, and see how by the expenditure of a given sum of money we can get the greatest returns. That is the reason we in the South have looked to sanitation as our greatest problem. The control of excreta-borne diseases being our biggest problem, we consider how best we can solve it.

Over a year ago we presented a plan to the Public Health Service to ask their cooperation in an experiment in using sanitary demonstrators. They readily cooperated in this experiment. We speak of sanitary demonstrators instead of sanitary inspectors, because we wanted to get away from the idea of law enforcement. Many parts of the South do not look on a Government inspector with any great favor. The people have a great feeling about their personal liberty, and so on. You can get them to do things by persuasion that you can not possibly get them to do by force. Further, these demonstrators were effective in getting the actual work started. Now, another reason why we started out with demonstrators: It is very difficult to get money from county boards of supervisors. As a rule, the amount at their disposal is very limited. They hesitate a long time to disburse their money or to raise taxes to get money. We can get $1,000 often where we can not get $5,000. It is easier to get that. Then, we will make a house-to-house canvass and see that privies are built. We can start them in health work, and, as a rule, when they do one piece of health work, they get interested in it all, and it is easier to follow it up with other health work.

We will then recommend that they put in a public health nurse. She is one of the great factors in health work. It is wonderful the amount of good public health nurses can do, and it is not difficult, after the supervisors have spent $1,000, $2,000, or $3,000, to get them to put up more money for a health nurse. The next thing is a full-time health organization. That is our development as we are carrying it on in our State.

First, recommend to the county that they put in a health demonstrator. This health demonstrator is supervised by a medically trained health officer. Five demonstrators are supervised by a health officer, furnished us by the United States Public Health Service. Those demonstrators are not medical men, not engineers; they are men of common sense selected because of their personal characteristics. We start them with a salary of $100 and necessary traveling expenses and furnish them an automobile. They are usually men that have been discharged from the Army; men of reasonable education and proper personal qualifications. We have to change about half. If we find they are not making good, we drop them. Some have done wonderful work. One demonstrator made such a success that $25,000 was often put up for community health work. We would never have got that county to approve $5,000 but for his work. By getting $1,000 from them at a time, we have first the demonstrator, then the public health nurse, and then the full-time health organization.

I am not going to take more time now, because I want the officer of the Public Health Service who has had charge of this work to tell a little more about it in detail. I would mention that we have in the adjoining county to Washington, in Virginia, about a half hour's ride from this place, the central headquarters for the full-time health organization being conducted in Arlington. Dr. Cox has that in charge and he will be glad to show you his organization. I hope some of you will be able to go over there and see a full-time county health organization in operation.

Dr. Draper. In Virginia, as I suppose in a good many of the other Southern States, there are a considerable number of counties in which practically no health work of any kind has ever been done before. Reports of typhoid fever, of dysentery, of hookworm disease, and other of the filth-borne diseases came into the State board of health regularly for years and years. The State board of health has done what it could to help them after an outbreak of disease, but preventive measures are needed.

The State had a small amount of money and succeeded in getting an allotment of a small amount of money from the Public Health Service, and the question was how to spend that money so as to get the greatest possible results. Now, in these counties that had never had any health work before, it was necessary to begin on a small scale. We devised a plan of agreeing to allot to a county $1,000 from State and Government sources if the county itself would appropriate $1,000. This would give us a budget of $2,000 for public-health work in the county. We paid a sanitary demonstrator $100 a month and used the balance for paying the cost of automobile transportation, for office expenses, and other incidental expenses that might arise. We had a written agreement with each county as to exactly what we were going to do, and the full time and energy and effort of the sanitary demonstrator was to be devoted simply to establishing the fundamental principles of sanitation. In some of these counties, the mortality rate for typhoid fever was something like 70 per 100,000, or 60 per 100,000. In other counties, infections with intestinal parasites were exceptionally high, and it was reasonable to assume that the things which needed correction related to soil pollution, therefore we devoted our time and energy to that one particular line. Of course, if influenza broke out, or a smallpox epidemic arose, we agreed to help them in any kind of emergency.

Dr. Williams and I visited 11 counties, and every one accepted our proposition. We mapped out three things to be done the first year. The first was to attend to the sanitation of all the towns of the county. In Virginia, when a community becomes large enough to form a city, it just removes itself from the county. The county is composed exclusively of small towns and the rural districts. Most of the typhoid fever and filth-borne diseases occur in small towns, which are in very bad sanitary condition, where people live closely together and where disease is readily transmitted from one to another.

We considered the sanitation of the towns the first most important thing to accomplish. The sanitary officer would first get the mayor and the town council interested in what he was going to do, then make a survey of the town, find out what the sanitary conditions were and what improvements were needed, and then go before the town council and recommend the passage of sanitary ordinances. Invariably, the sanitary ordinances would be cheerfully and quickly passed. It was one of the easiest things we found to do. They had no idea that anything was going to happen after the ordinance was passed. The next thing was to secure the construction of the type of sanitary devices we were going to use. In some of our towns, we used septic tanks and, in others, the can and box system. We would have to find the contractor, get the work done and see that the sanitary equipment was actually installed. I may say here that sometimes, in a town of 200 homes, it has taken a solid year to really get a can and box system established. It has taken the most constant, energetic and persistent efforts to get the system actually installed.

The second thing we outlined for ourselves was the sanitation of every schoolhouse in the county. It didn't seem very sensible to talk sanitation and personal hygiene and other kinds of health work and yet leave the children the examples of the horrible, indescribable conditions which are present everywhere; so we made it a point to make every school building in the county sanitary. In order to do this, we first appeared before the school board and explained the thing to them. Then we got the business men interested in it, and they have always been the greatest help. We also secured the cooperation of the supervisors, the teachers and the patrons of the schools.

The third objective was the extension of the work into the rural districts as far as possible. We didn't know how far we would be able to go in the rural districts, but we intended to do as much as we could. But now some of our counties have been going for a year, they have completed a year, and I can tell you some of the results.

Take Henry County, for example. It had a mortality rate from typhoid fever of 70 per 100,000 and never had any health work. Some enthusiastic individual asked if I couldn't come over, or send someone down there to give a public health talk. So I went down and found an enthusiastic Red Cross lady who had conceived the novel idea of running me in on the end of a Chautauqua before anyone knew there was going to be a health talk. I didn't enjoy the idea very much, but I did it, and when I got through there were still a few people left. She said, "We do need health work in this county, we need health work in the worst way, but our supervisors won't support it. We haven't been able to get their interest but, as a Red Cross Chapter, we will give you $1,000, and you put in $1,000 and come down here and establish this kind of work." I told her that it would not be in accordance with the policy of the National Red Cross and that if the local authorities would not give their indorsement to this work and were not interested in it, it was up to them to get authorities who were interested in it. I agreed, however, to present the matter to the supervisors at their regular meeting.

The supervisors did appropriate $1,000 for the work, and we sent a sanitary demonstrator down there. Several of the towns appointed sanitary inspectors and paid for them out of their own resources. After about four months, people in the county began to say "It is too bad to get this work started down here and have it stop after a year. Can not we look forward to something in the future?" We told them about the State and International Health Board unit, the $5,000 unit, which requires an appropriation of $5,000 from county sources for the conduct of the work, and the supervisors appropriated $5,000. The supervisors did that all themselves without the aid of outside agencies. They said, "We do want to do health work." They are going to employ a nurse and pay for everything out of the county funds. That same county got the school board interested in school sanitation, with the result that they gave us $7,000 to build septic privies at every schoolhouse in the county.

In another county we went before the board of supervisors one year ago and told the people about health work. Some of the people who came to the meeting got up and said it was the worst nonsense they had ever heard and they did not want anything like that put across in their county. But the people as a whole became interested and, in the face of the greatest opposition, the county made an appropriation. A week ago I went there again. There were 30 or 40 people in the room; some of them had been opposed to health work the previous year. They said that the work ought to be continued, they had not understood what it was a year ago, but that they believed in it now and appreciated it and wanted it. And when we got through, the chairman said, "Gentlemen, the matter is before you." One of the supervisors who came from the district which offered the greatest opposition the previous year said, "Wal, I reckon as long as this work has gone along for about a year, we might as well continue it." The next thing, $1,500 was appropriated for health work instead of $1,000.

In Rockbridge County we did the same way as in other counties. In Rockbridge County there have been constructed 2,500 sanitary privies during the year. They had a sanitary demonstrator, T. J. Robinson, who was peculiarly and happily fitted for public health work. He organized the county and divided it into different districts. He got a volunteer worker in each district to send him the names of the people in that district, then he wrote letters and sent literature to every person in the county, telling them that it was the law that they should have a sanitary privy and that it was expected that during a certain week, "sanitation week," everyone in the county would carry out the provisions of the law. It was not stated that it was compulsory, or that anything would happen if they didn't do it. It was simply pointed out what the law required and what the sanitary inspector wanted to accomplish. It was very carefully worked out in an elaborate campaign with many newspaper articles. Every person who advertised in the paper had a sanitary phrase to go along with it. We carefully followed this with follow-up letters. The result of it was that, during "sanitation week," we had constructed 1,800 privies, not all pits, some of them were septic privies. In limestone regions, concrete vaults were built. In the particular places where we constructed them, they were the best possible type that could be used. That is the record for just one man. I think Mr. Robinson would like to have Dr. Rankin's valuation put upon his work.

Another county also gave us $5,000 to do the health work. Rockbridge County had previously turned down a $5,000 unit. They will probably put in a $12,800 budget; there is every reason to believe that they will. By beginning with the fundamental principles of sanitation, with just one man working along certain restricted lines, on a common-sense basis, we are able to build up a larger health organization. People are not interested in the building of privies fundamentally, and they have to be taught to do big things in public health work. They must develop the work in logical sequence.

Dr. McCormack. I am constantly impressed with the danger of overemphasizing the importance of some one or other of the activities in general that we are doing and not getting ourselves firmly based upon the organization of county health departments as the fundamental that we are all after. I think the plan Dr. Williams suggested this morning of a county health department is a most excellent one, but it will fail exactly when he fails to get a good county demonstrator, fails to get a good nurse, and, when you fail to get a thoroughly good public health nurse, which is, of course, essential, the plan is a failure. The important thing is that after that, when we do our other work in the organization of our tuberculosis campaign and our child-welfare campaign, that that be done in counties that have organized a more or less adequate county health department. I don't believe it does any good to examine all the school children in a county, unless the work of that examination is going to be continued by a department that can use the material gained. What good does it do to build a hundred sanitary privies in a county, do the memorial work or any work, if you leave that county and do not leave behind you an organized health department? For that reason, it seems to me that it is of extreme importance that we stress to ourselves the value of building permanent organizations, as the fundamental thing we have to do is to build up county health departments and devote our entire knowledge to building them. We have had no other suggestion of quite as much value as Dr. Williams's.

The Surgeon General. There are some exceedingly valuable and interesting papers for this afternoon. There will first be shown a malaria film, gotten up by Dr. Abercrombie and others.

Dr. Lumsden. I would like to submit a resolution, in order that the committee may consider it during the recess. I want to read it to the conference, so that, if there is some suggestion, it might be offered before it goes to the resolutions committee. The time will be short for the committee:

Whereas (1) over 53 per cent of the population of the United States is rural and the food supply for our whole Nation is dependent upon production in the rural districts; and

Whereas (2) physical defectiveness and preventable diseases have been found by extensive, careful studies to be as prevalent in our rural as in our urban population and only about 3 per cent of our rural population is served by local whole-time health departments approaching adequacy; and

Whereas (3) the promotion of rural health work is obviously of local, State, and national importance and, as has been demonstrated, may be secured to the highest permanent advantage by cooperative activities of local, State, and national governmental health agencies; and

Whereas (4) for the Public Health Service to proceed in a businesslike way in effecting its cooperative arrangements with State and local governmental health agencies for the promotion of rural health work a continuing appropriation is necessary; and

Whereas (5) the application of the principle of Federal aid extension to rural health promotion appears entirely logical, consistent with the theory and established practices of our system of government, and is urgently needed at this time: therefore be it

Resolved, by the conference of State and Territorial health officers with the Public Health Service, that the members of this conference individually and collectively indorse the principles of legislation contemplated by the Lever rural health bill introduced in the Sixty-sixth Congress and agree to advocate such principles with a view to bringing about a Nation-wide popular demand upon the Congress of the United States for such legislation.

Adjournment to 2.15 p. m., Thursday, May 27, 1920.

AFTERNOON SESSION, MAY 27, 1920.

The conference reconvened at 2.30 o'clock p. m., the Surgeon General presiding.

Dr. McLaughlin submitted the following report:

ENDEMIC INDEX AND COMMUNICABLE DISEASE CONTROL.

As you perhaps know, I happen to be in charge of the division that is obligated to do whatever is possible to prevent the spread of disease in interstate traffic. I am here to stress the importance of communicable disease control. As you perhaps remember, some years ago one of the most successful of our low comedians had a song which made a great hit all over the country, "You can not play every instrument in the band," at least at the same time, but what you can do and what you should do is to play the particular instrument that is assigned to you for whatever it is worth. My good friend, Arthur McCormack, has intimated that I would emphasize, and I think he suggested I would overemphasize, any particular subject which happened to be assigned to me. That may be true—I will not take issue with him on that—but I desire to say that the communicable disease control is, after all, the fundamental function of the health department activities. I don't say it is the most important section of the health department, but it is the best understood and goes back in a straight line to the beginning of health departments, and, if we do not develop this properly and logically, we have little claim on the people or the legislature for the development of the fad of the moment. Now, if anyone should ask me what is the most important function of the health department, or what is the most important phase of public health, I would have no hesitancy in saying that the most important phase of public health work to-day and the one that promises the best results now and in the future years is child hygiene. There is no question for argument. You may struggle with the present generation, with the old man, and with the middle-aged man, and with the young man, but you get nowhere, because they were not trained in youth; they have acquired their habits and are unchangeable to a certain extent. You must begin with the young generation. Your biggest problem and your biggest success you will find in child hygiene beginning with the prenatal care of the mother, the care of the preschool child, the care of the school child, and right through into adult life.

I make that confession freely, but I want to come back to communicable disease control, because that is fundamental, and if you neglect the proper development of that you do it to the detriment of the public health. We haven't controlled communicable diseases. I don't believe there is any public health administrator or executive officer who has a better, fuller cognizance of the importance of child hygiene and other public health work than I have, but I still say you ought to complete your machinery for the control of communicable diseases as rapidly as possible. What is control of communicable disease? Upon what is it based? It is based in most instances upon mortality statistics. Mortality statistics are used because they are infinitely superior to the morbidity statistics that we have. If we had proper morbidity statistics, we would work on morbidity statistics rather than mortality statistics, for, as preventive officers, we are dealing in mortality statistics with things that have already happened. We are locking the stable after the horse is out, and too many of us as health officers are going along in the position of the man who does not foresee a situation, but collides with it. What actually happens is, we suppress epidemics and stop outbreaks after everybody knows there is an epidemic. Sometimes the health officer is the last one to think about it. I include myself in the same category. What we need is such a close check upon the prevalence of every communicable disease that we shall know immediately when it has exceeded the normal and establish a normal for that particular health unit, so that it can be called to the attention of the central office and action taken. What are the facts? Ask yourself what knowledge you have of the incipient epidemics. What check have you? How do you know that you have an incipient epidemic? Isn't it true that in the majority of cases your knowledge comes when it has assumed such proportions that everyone knows there is an epidemic? Let us be fair with ourselves. Is there any way in which this thing can be remedied?

In many States it is an ideal set far into the future, because it involves the fair, square cooperation of the medical profession; it means that the medical practitioner realizes he is a health officer without pay and that he has a moral obligation to report immediately cases of disease. When he reaches that point, when he realizes his obligation, the control of communicable diseases will be less difficult. I am not blaming the health officers alone; I am blaming also the profession and the attitude of the general public, because, after all, there are thousands of cases that never see a doctor, the reporting of which are just as essential in the prevention of the spread of disease as those that come under the doctor's care. If we go about it in the right way, it is not entirely hopeless, but it will be slow work. As I say, certain States have some such system. In others I am informed that members of the State board of health, doctors, do not report their cases of contagious diseases. Yet, with a smug complacency, they think they have a real health department and control of contagious diseases.

Now the interest of the Public Health Service in the control of communicable diseases in States is due to this fact, that, while we are charged with the prevention of the spread of disease from one State to another and in the country as a whole, we are told by Congress, in conformity with the Constitution, accentuated year by year in statutes, that we must proceed in this way. We must proceed by utilizing the State machinery, the State laws and ordinances, and only where they are inefficient and ineffective are we permitted to apply Federal ordinances, and then the Federal ordinances must be given to the State and local authorities for carrying out, and only in case of their failure to do so has the Federal Government any authority to act.

The result is that it is perfectly assinine for the service to complete its own machinery. The goal of this work is to develop a State organization that will have the machinery to carry out the prevention of disease from a Federal as well as State standpoint in this country. That involves developing in every State health organization a real active division of communicable disease control. Now, having that object in mind, the Public Health Service made a start last year in detailing to the States epidemiologic aids. We hoped for 40 of these; we got 8, due to the demands for the personnel in other divisions. These men were men who had been through the extra-cantonment campaign. Any man who went through that had as much training and experience as in 10 years under ordinary conditions. They were brought into Washington and given an extra intensive course in communicable disease control, and then sent out to 8 different States, and their experiences are interesting and enlightening. In some States, two States particularly, I will not mention them by name, they already had morbidity statistics in such shape that they could be compiled for a period of 10 years. The obvious epidemics were eliminated and an endemic index for each health unit in that State for each month in the year was obtained. It is set down, and now, as the morbidity reports come in weekly or monthly, they can check them against the index and know immediately whether they have more than they ought to have for that disease in that community in that month of the year. In other States they have practically no morbidity reports whatever. They have patchy reporting of mortality, and the best you can get in the way of endemic index is a conjecture or a guess, and then, when you have this, you have nothing to check up against. I am not painting a blue picture, because I am a born optimist. I want you to know the fact; I want you to get out of the position of smug complacency and have adequate communicable disease control. I hope we shall be able to establish in time a morbidity area at least as large as the area is now for deaths, and until we do that we can not say we have any basis for decent, proper communicable disease control.

I hope the United States Public Health Service will be fortunate enough to have the personnel available to place in every State of the Union a man whose business it will be to assist the State health officer to improve the condition of communicable disease control. There is not a State in which he would not be useful in that capacity, and some States need two or three men. This is in direct accord with the policy to build up sanitary engineering departments for the control of water supplies in States which I spoke of yesterday. The two are really part of one problem. I hope I will not be misunderstood in putting such stress on communicable disease control that one would think I am blind to the other important problems, especially child hygiene, but I do want to stress this for the reason that we have not been getting anywhere near communicable disease control.

Dr. JEPSON. I have served for 11 years as health officer in a city of 40,000 people and for 7 years as a State health officer. As a result of that somewhat long experience, I want to state that outbreaks of disease are largely due to three causes, all of which can easily be obviated: One, failure to make report in cases of communicable diseases; two, delay in reporting such cases; and three, errors in diagnosis. The last point may be best illustrated by referring to smallpox and a recent experience. In the mild form of smallpox with which we have been acquainted in the last 20 years there are numerous errors in diagnosis, the cases usually being taken for varicella by even the intelligent physician. Within a week there were reported to my office seven or eight cases of an eruptive disease which the health officer called smallpox but which a physician, older in practice than he and much longer in that town than he, said was not smallpox. I sent our epidemiologist to investigate, and he found that the first case was in an adult, and the mistake of pronouncing it chicken pox was absolutely inexcusable. That patient has been allowed to go about the town without any control whatever, and seven or eight cases resulted in that failure in diagnosis.

As a local health officer, I have had reports of smallpox made to me on the fouth or fifth day of the eruption. This was inexcusable and I consider it disgraceful to any physician. We have often, unfortunately generally, throughout the country failed to receive reports of these acute infectious cases at all, some physicians positively refusing to report and others failing through neglect. I have a thought to throw out in this connection, which might obviate all these errors, if it could be put into universal practice, and that is that every physician, first of all, should be taught, and every parent, secondly, should be taught promptly to isolate every case of acute febrile disease, especially in a child, until a diagnosis can positively be made. Why should you, in acute cases, whether eruptive or otherwise, permit a child or other person to continue in contact with other members of the family when that case may develop into smallpox or scarlet fever or diphtheria, or other disease with fatal termination? If every mother were instructed to strictly isolate her child, that danger would be obviated. If the careless, indifferent doctor should come in later, he would find the mother wiser than he. I hope that you will try to instruct the physician coming within your observation to warn parents of the danger of exposing the sick to the well, and finally to have them educated to isolate promptly every acute febrile case.

Dr. SCHERESCHEWSKY. Owing to the fact that we have a long program, talks will be limited to two minutes.

Dr. CAREY. In Massachusetts we have had this system which Dr. McLaughlin speaks of in force for some time. We believe, however, that a more accurate index is one which we call the median endemic index. The reason for this belief is that in using the usual endemic index one excludes all epidemics and substitutes for these exclusions a figure that is believed to more accurately represent the proper index for the period. Our median endemic index is arrived at by arranging the reported incidence in arithmetical sequence and choosing the median figure. This does not necessitate exclusion or substitution, and it is surprising how often the reported incidence of the more usual communicable diseases will coincide with our index. In a mild infection such as we are now experiencing with measles and scarlet fever, this approximation does not hold, merely because of the large number of unreported cases by householders who, because of the high cost of medical attention, do not call in a physician. The cure for this condition is, of course, to educate the householder to report the cases as they occur in his family.

There is one thing to which I would like to call your attention. I do not know that you men of the service realize the help and assistance that your weekly report is to us men in the various States. Because of its value we are very desirous of its being brought up to date. There is delay in publishing these weekly reports, and I find, taking that period when they ought to occur as at least 10 days after the current week, that in 13 States the report was two weeks late; in 44 States, three weeks; there were 144 reports, four weeks; 4, five weeks; 59, seven weeks; 1, eight weeks; 2, ten weeks. A report that is so delayed is of little value to us save as a matter of record. It would seem as though the service might adopt the same regulations that your sister bureau, the Census Bureau, has and not publish the report unless it is in on time.

Dr. Dowling. I am sorry to say we plead guilty to the charge of Dr. McLaughlin. If anyone can suggest how we can get the doctors to report promptly, we would appreciate it very much. Dr. McLaughlin sent us an epidemiological aid, but he was not permitted to stay. If he could have continued in the work I believe we would have made great progress. Like the gentleman from West Virginia, in my opinion, if there is doubt, chicken pox should be reported as smallpox and so treated until diagnosis is determined. Louisiana has been charged with a number of deaths from smallpox. We make the frank admission, though we realize it is a disgrace to our intelligence. We are not able to get our births reported, barely able to get reports of deaths, and, unless we have better cooperation from the doctors, as well as the people, I don't know how we can accomplish more. At present we can not get grand juries to indict or our courts to prosecute. We furnished evidence against a prominent physician, and they replied, "He is such a prominent physician, we can not afford to prosecute him." We furnished later a report on another physician. The statement came back that he was the "judge's cousin," and for that reason they couldn't prosecute him.

Dr. Schereschewsky. Any further discussion? The next subject is, "Better Morbidity Reports."

BETTER MORBIDITY REPORTS.

(Dr. Warren submitted the following report:)

It is not necessary for me to go into the importance of better morbidity reports. I want to state that we now have 32 States with collaborating epidemiologists. There is no reason why every State in the Union can not avail itself of the system of collaborating and assistant collaborating epidemiologists, with the advantage of saving itself some postage. I am sorry to see that the Post Office Department has ruled against sending laboratory specimens by mail under penalty. They said that it was impos- t this subject had been brought up numerous times with them by the Agricultural Department in regard to samples of soil sent in that way, and on all occasions they had ruled against it.

With a view to obtaining better reports, Congress was asked for $100,000 to put in each of the 31 States that were then reporting a statistical clerk who would aid the States in getting such reports as the Public Health Service wanted, but, owing to the fact that Congress for this year was cutting down in expenditures, they did not grant this increase; but I feel sure, in time, when the Treasury gets in better shape, we will be able to furnish a statistical clerk to States cooperating in this regard with the Public Health Service.

There has been some criticism of the Public Health Reports because they contain morbidity reports which are out of date and of no immediate use to the health officers. The Public Health Service feels under obligation to publish all official morbidity reports received even though they be too late for immediate use by health officers. Such reports may be of use for statistical purposes at later dates, and, further, may furnish a comparative basis for improvement of these reports.

It is desired to invite the attention of the State and local health authorities to the weekly telegraphic reports as published. It is desired that these weekly telegraphic reports reach the bureau on Monday or Tuesday of each week and contain the report of the previous week ending on Saturday. These telegraphic reports should cover in detail any unusual condition. They should not summarize morbidity reports by counties nor by cities unless some unusual condition exists in the county or city in the State.

The Public Health Reports contain each week's morbidity reports as received from cities of 10,000 population or more. There are 709 cities in the United States in that class. The service has been receiving fairly good reports from about one-half of these cities. I believe 535 cities make some kind of report. I wish to be clearly understood that the Public Health Service desires in all cases to make contact with local and municipal health authorities in the collection of morbidity reports through the State health officers, but the method of collecting from the cities such reports as published in the Public Health Reports was instituted years ago, and until a State can furnish from those cities better reports than those now obtained it is desired to continue the present method. It is realized that this method is not in line with the general policy of the service, but it is of great advantage to continue it until some better method is forthcoming.

I would like to have some discussion as to what State health officers think of the plan for a weekly telegraphic report from, say, 100 cities in the United States scattered geographically so as to obtain a fair index as to what is occurring as to unusual conditions. Such reports would have to be received on Monday morning for the week ending on the previous Saturday. These reports would be summarized and mimeographed, then telegraphed to the States and given out to the press. To obtain these reports it would be necessary for the 100 cities selected to report direct to the bureau by teleraph and not to the State health authorities. However, it will be necessary to obtain an appropriation for this purpose before such plan can be instituted.

There has been some criticism as to the delay in receiving the Public Health Reports each week. This delay has been, for the most part, due to the crowded conditions in the Government Printing Office. Great efforts have been made to avoid this delay by the bureau and these efforts will continue.

TEETH AND MOUTH INFECTION.

Maj. L. G. MITCHELL. I will not take the time to express my pleasure in addressing you. After the "measles and mumps" epidemic in our camps, 1917-18, the Surgeon General's Office recognized more than ever the close relation existing between infection in bad mouths and systemic diseases. The heavy death rate from these diseases was unusual. A partial survey disclosed mouth infection in every case examined. The film "Come Clean" was made at the Army Medical Museum, for the purpose of teaching the soldiers the importance of keeping their teeth clean and having their mouths freed from all infection. In making the film I incorporated features of interest to the general public, so it would be of value after the war. It is attracting considerable attention from the professions as well as from the public for it shows how infection from bad teeth reaches the various organs of the body, also the importance of the deciduous teeth and the causes of malocclusion which results in much of our malnutrition among children; matters which our medical men should be in close touch with. Foreseeing possible criticism from some, I asked Col. Frank Billings to direct the more scientific part of the picture, wherein we trace the infection from the mouth to various parts of the body; also to write the titles. The picture starts with an interesting story of camp life. The hero is ridiculed for brushing his teeth and when they hide his brush a fight ensues. He then tells his story. From this we go into the subject of oral hygiene in a constructive way. The Surgeon General expressed his approval by allowing 30 copies to be made, 23 copies being circulated by the Department of the Interior.

This film expresses the opinion of many of the country's leading surgeons, pathologists, and research men. All who are interested in health conservation, in the prevention of communicable diseases, and in the health of our children should get in closer touch with these important matters for they are fundamental. The masses of people no longer die from great plagues, but from a simple infection the focus of which would give no trouble. Let us work together to keep the blood free from the disease-producing bacteria.

TRACHOMA.

The SURGEON GENERAL. The next subject is trachoma and Dr. McMullen is the father of trachoma.

Dr. McMULLEN made the following report:

In view of the fact that the Surgeon General has introduced me as the father of trachoma, I will omit any reference to the ancient origin of this disease. Since trachoma is not the direct cause of death, there are no mortality statistics to emphasize the importance of this dangerous communicable disease to the public health officer, but it presents a problem more largely economic than any other in the whole field of preventive medicine. As is often the case in smallpox, the disease is classed as some benign condition until it has attacked large numbers of people with damaging effects to their eyes. As Drs. Dowling and Jepson have said about smallpox, it is easy to get an opinion that it "isn't" in most cases.

The incubation period of trachoma has not yet been determined with any accuracy, but it appears to be prolonged over a considerable period. What the health officer wants to know is some practical standard by which he can readily recognize a condition of the eyelids which should not be permitted in schools or other meetings, as a protection to the public health. He is not so much concerned with hairsplitting diagnosis which postpones any preventive measures until some damage has occurred. It appears that there is no such thing as an agreement upon the diagnosis of trachoma in which everyone would concur. This was demonstrated at the New Orleans meeting of the American Medical Association last April, as those of you who were present will no doubt agree.

Those of us who have had to deal practically with trachoma realize that it is a serious menace. Trachoma surveys were made originally in Kentucky about 8 years ago when trachoma prevention work was commenced. Since then surveys have been made in Tennessee, West Virginia, Virginia, Florida, Texas, Arkansas, Missouri, and other States. In speaking of smallpox, Dr. Dowling suggests that the suspicious cases be acted on as positive cases and excluded from gatherings. This is an excellent and practical rule and one which should be applied to trachoma and allied conditions regardless of the ever-present fellow who was born in the objective case. Follicular conjunctivitis or folliculosis could and should in this way be excluded. This condition is easily curable and could than be returned to school with little loss of school time. This course is pursued in the Philadelphia schools.

Health officers are continually embarrassed with conflicting diagnoses of trachoma and it would be well if the Surgeon General could name a committee consisting of some of the prominent ophthalmologists of the country to work in cooperation with the service in the hope of standardizing the diagnosis.

Perhaps the health officers who have experienced difficulty in handling these eye cases will express themselves.

Dr. McCormack. I think trachoma is one of the most serious problems that confronts the health officer of Kentucky. I am perfectly confident that every health officer in the United States who is now confronted with trachoma has a morbidity problem, unless we get rid of the foci of the disease, particularly in certain districts. Dr. McMullen has treated very many of these cases. Our own rule in Kentucky is to exclude from school all cases of trachoma and all cases of follicular conjunctivitis, unless they can clearly be stated not to be trachoma. All of those cases ought to be treated, and I think this is probably the only practicable standard that can be adopted. All the cases, the treatment of which is a simple cautery, ought to be precluded from school. They can be gotten back in school, but not any quicker, if there are no defects. They can all be relieved immediately and, if the ones who have follicular conjunctivitis are treated, there is no harm done to anyone. I believe it is of the utmost importance that a board of experts be constituted by this service that will clearly establish on definite and scientific lines, after a study of the question, the differentiation in diagnosis of trachoma. The men on the board should bring in the constructive verdict on the problem involved and secure the support of the ophthalmology profession, so that we can help to get rid of this tremendous disease.

There are thousands of children in this country who are doomed to inefficiency and a large number to eventual blindness. It is not a matter for academic discussion, or that we have a right to dally with. It is a tremendous problem that involves large numbers of our children. I can not permit an opportunity to pass without paying a personal tribute to Dr. McMullen on his work. Coming into Kentucky as he did, walking or riding on a horse over roadless country, going into homes and schools where the blind led the blind, finding the enormity of the problem, working hard in a hard country in a hard way for a solution of it, and finding a method of relief. It does not make any difference how many doubting Thomases there are, or how slowly it is adopted, it must be adopted by every intelligent man everywhere by members of the profession every where. I want to say there is no other distinction that this service has attained in all the years of its history which entitles it to more credit and more glory than the unassuming work that was done by John McMullen in the mountains of Kentucky.

Dr. DOWLING. I merely want to indorse what the previous speakers have said. When Dr. McMullen read his paper before the medical conference in New Orleans last October I took occasion to ask a few of the doctors doing special work how many cases they had treated during the last 12 months, and it was surprising to get their reports. The regulation of the State board of health requires that all cases be reported. The city boards of health do not require it. When I was doing eye, ear, nose, and throat work I saw an average of 20 to 30 cases a year. It appeared that frequently doctors were in doubt relative to the diagnosis of eye trouble as trachoma and almost invariably gave the patient the benefit of the doubt.

Dr. McDONELL. I would like to second the suggestion that a commission be appointed to study and outline and diagnose the length of time that these children be excluded. Dr. McMullen made us a visit in Jacksonville a few years ago and he went over with the different eye men in the city 25 or 30 cases we suspected of being trachoma. Following this visit all of the eye men called this condition trachoma except one man. Since that time some of them are beginning to weaken, and it is throwing a good deal of responsibility on me as to the length of time to keep these children out of school. That is what a health officer wants to dodge in a city.

PROVISIONS FOR LEPERS.

Dr. McCoy made the following report:

I assume that I am expected to talk on leprosy, and am sure the first thing you will want to hear something about is the Federal leprosarium. There have been heartbreaking delays in connection with the establishment of this institution, but if any of you have ever tried to place a flourishing colony of about 300 lepers in your own community, or in one adjacent to that in which you live, you will understand the difficulties which have confronted the board appointed by the Surgeon General to select a site for the National Home for Lepers. I hope that in a very short time the final decision will be made and the Government will be in a position to take care of the lepers of the country.

We have recently been much interested in a new method of treatment used by Drs. McDonald and Dean in Honolulu which appears to be proving satisfactory. These gentlemen use hypodermically the ethyl esters of the acids found in chaulmoogra oil; this is a modification of the treatment which Dr. Heiser resurrected and applied extensively in the Philippines some five or six years ago. A report of the work is in press at the present time and details will be available in the relatively near future.

Recently we have been interested in the distribution of lepers in the United States with respect to the locality of infection, and the data at my disposal indicates that leprosy is not communicable in our northern communities. I am most anxious to have any information which any of you may have on this point.

Dr. TROTTER. I would like to say a few words about leprosy. The establishment of a Federal leprosarium is being vigorously opposed by everybody. You are probably aware that we have a receiving leper station on the outskirts of Honolulu. The people pay no more attention to this hospital than you would to a general hospital. We have 99 cases on hand there now, the oldest 62, the youngest 7, the average age being 23. We are administering to all these people the new remedy for leprosy, which is being made in the College of Hawaii by Dr. E. L. Dean, and is administered by Acting Asst. Surg. J. T. McDonald, of the United States Public Health Service. Dr. Dean does not state positively that the present method of treatment is a sure cure for leprosy, but the results so far attained have been most encouraging and warrant the belief that a most important advance has been made in the treatment of this disease. As a result of the treatment given during the past year, 48 patients were paroled and to date none of these have returned to the hospital. The missionary work done by these paroled patients has been wonderful. We are now admitting patients, who have come voluntarily to the Kalihi Hospital for treatment, the disease in any case not having existed for longer than six months. The board of health has the confidence of the people, and this alone is the most encouraging aspect of the leprosy situation in Hawaii. In previous years the Hawaiians suffering from leprosy would be hidden away, possibly for five or more years, until the patient became practically helpless, when he would be brought in and surrendered to the board. This condition no longer exists. Patients suffering from leprosy are coming in, waiving an examination by a board of physicians, and willingly accepting the decision of the attending physician as to whether or not they are lepers. The board of health expects to hold a parole board in July, and at that time it is expected that many patients will be released from the hospital on parole.

Dr. McCormack. In Panama, in the absence of Dr. Grubbs, who is doing exactly the same work in Panama for the service, the receiving station is in the hospital. All the patients are brought there and examined. They feel no anxiety about the disease. In addition to indorsing the recent modification of Dr. Heiser's treatment, I want to indorse especially the social relation in the care of the patients. Due to Dr. Grubbs, it has more than doubled the population as it has in Hawaii, and the people are sending their cases in very much earlier, which makes the treatment more hopeful. I hope this idea will be taken into consideration. These people are not treated as criminals, or as hopeless cases, but given every sort of humanitarian attention. They are not put in an institution, but given little cottages where they can be cared for humanely. It is of the utmost importance that they come and stay throughout the treatment. Dr. Grubbs more than doubled the population.

The Surgeon General. Before going to the next subject, Dr. Creel, chief of the quarantine division, wants to make a statement which is not strictly on the program, but one in which we feel that State health officers have a deep interest, both from a sentimental and from a health standpoint, and that is with the return of the soldiers' bodies from France.

RETURNING BODIES OF SOLDIERS FROM FRANCE.

Dr. Creel. On several occasions inquiry has been made of the bureau as to the propriety and safety of permitting public funerals; more especially the opening of the caskets and exposing the bodies of the returned soldier dead. The attitude of the bureau on this subject is probably the attitude of most practical public health officials with respect to the disinterment of the body that had been embalmed or otherwise treated and disinfected. It was deemed to be of no danger from a public health standpoint—certainly no danger from a public funeral and probably not from the opening of the casket, and this was the response that the bureau made to such inquiries.

More recently, however, Dr. St. Clair Drake took up the matter with the War Department, and in reply he received from the Quartermaster General the following message which sets forth the attitude of the War Department:

> Reference your telegram May 6 to Secretary of War. No authority this office prescribe regulations for handling of soldier dead by relatives or other persons after delivery of body in the different States. This a matter for State regulation. Thought most States treat disinterred bodies as infectious and dangerous to public health and surround the handling of such bodies with most rigid health precautions. We are conforming to stringent mortuary regulations of European countries as to technique of disinterments and preparation for shipment. All bodies carefully and thoroughly treated with disinfectants and deodorants by American embalmers in Europe and placed in hermetically sealed caskets specially designed for this work, each casket

rigidly tested prior to use and carefully scrutinized after receipt with body in United States and if body is left undisturbed in its sealed metallic lined casket presents no source of danger to the community. Agree with you that uniform regulations all States highly desirable. Viewing remains accomplishes no useful purpose, as identification is clearly established before permit is issued for body to be returned to relatives. A gruesome spectacle at best and unless guarded by most rigid regulations may prove a source of danger to the community notwithstanding elaborate sanitary precautions taken by disinterring embalmers.

When inquiry was first made of the bureau on this subject the cemeterial division of the War Department was telephoned to and asked as to what precautions would be taken on the other side. They stated that all bodies had been embalmed or otherwise appropriately prepared for return, thus giving the bureau the impression that they were all bodies that had been buried a long time. As a result of this telegram from Dr. St. Clair Drake, the Secretary of War requested the Surgeon General of the Army to confer with the Surgeon General of the Public Health Service on this subject, because the War Department, as evidenced by the telegram from the Quartermaster General, was opposed to public funerals. At the conference with the officers of the cemeterial division, the bureau representative pointed out that from a public health viewpoint there was no danger in opening the casket of a body that had been disinterred after prolonged burial. An Army officer stated that a number of these soldiers had died from influenza and had been recently buried. This, of course, might make a difference. There seems to be no special good accomplished by opening the casket. It is a gruesome spectacle, and despite the recognition of the fact that there is no very great danger, nevertheless, it is believed that there should be some uniform practice against public funerals, or rather against opening the caskets of soldier remains disinterred in Europe and brought back to the United States for reburial.

Dr. DRAKE. Just prior to sending these telegrams to the Surgeon General of the Army and the Surgeon General of the United States Public Health Service the State Department of Health of Illinois was besieged from all quarters of Illinois as to what ruling would prevail affecting the handling of the bodies of returned soldiers. In the absence of any instruction I wired the Surgeon General of the Army and the Surgeon General of the United States Public Health Service that some ruling and uniformity of action appeared to be desirable. Great pressure was brought to bear upon the State authorities to permit opening the caskets and to hold public funerals. Our judgment was that there would be no great danger in opening the caskets. In ruling that way our action was in accordance with the recommendation of the Surgeon General of the United States Public Health Service. We did urgently advise against opening the caskets, but if they were opened it was required that they be opened only in the presence of one member of or some person selected by the family. Our ruling appears to work to the satisfaction of all.

The **SURGEON GENERAL**. I think that is an excellent suggestion. I think there should be some rule which would stop people from having the caskets opened.

MIGRATION OF TUBERCULOUS PERSONS.

Surg. Smith made the following report:

Migration of tuberculous subjects is still a problem. The causes are various and some of them can be removed by concerted and persistent efforts. When the average family doctor finds a case of tuberculosis his first instinct is to send the patient away to some other place. There are several reasons for this. The general practitioner is not skilled in the treatment of tuberculosis nor is he interested in it. He has been taught, unfortunately, to send all his tuberculous patients to a specialist in tuberculosis, in a special institution and a special climate. He believes that the patient expects this advice as soon as the diagnosis is announced. The physician continues to give this advice regardless of the fact that there are not enough special institutions or specialists in the world, and never will be, to receive and treat more than a small fraction of the tuberculous needing care. As a result, diagnoses are delayed or withheld by the doctor, symptoms are concealed by the patient and later, like a wounded wild creature, the hapless patient hides himself, concealing his disease among the marts of industry and trade. Tuberculous patients are far too numerous to relegate exclusively to specialists. They constitute approximately one-third of male patients needing hospital care. Moreover, in the hands of skilled physicians the home treatment of tuberculosis is highly successful.

We need better undergraduate teaching in medical schools and a chair of tuberculosis in every medical college. We need provision for a limited number of tuberculous patients in every general hospital in the country for the proper training of personnel and for the proper preliminary training of the patients themselves preparatory to beginning home treatment under a family doctor in sympathy with the plan and wise in all the methods of treatment. Such a plan would popularize treatment in the home climate and do much to counteract the pernicious advice which has been routine for 20 years by which patients are urged to seek a change of climate.

The policy of opening general hospitals to tubeculous patients was advocated by the National Tuberculosis Association at its annual meeting in 1916. The Surgeon General of the Public Health Service advocated the adoption of such a policy in a telegram to the American Medical Association at its annual meeting in 1920. There is no doubt that in this single measure, so easy to accomplish, so pregnant with possibilities of good, is to be found one of the most important means to further the training of practitioners of medicine in this important subject, to set the stamp of scientific approval upon the practice of retaining tuberculous patients in the home climate, to counteract the absurd fear of tuberculosis common among the laity, to insure earlier diagnosis, and to encourage the hospitalization of patients who otherwise would certainly be deprived of it. It is to be earnestly hoped that every exponent of measures to improve the public health will voice an approval wherever opportunity arises of this important measure.

REPORT OF COMMITTEE ON RESOLUTIONS.

Dr. **DRAKE**. Mr. Chairman, your resolutions committee has received but four resolutions. All have been carefully considered and reported back to the conference with the recommendation that they be adopted. The first is as follows:

Resolved, That any laws concerning the sanitation of public conveyances and public railway stations should contain a clause penalizing the public for befouling such conveyances and such stations, for we recognize that unclean and befouled public conveyances and stations are made so by dirty people and they should be penalized for their filth.

The resolution was adopted.

Dr. DRAKE. The second resolution is one prepared by the committee at the suggestion of the conference. It reads as follows:

Whereas there has been introduced in Congress a bill (H. R. 10925, S. 3259, known as the Sheppard-Towner bill) making provision for promoting the care of maternity and infancy in the several States; and

Whereas there has been created in this bill new Federal and State health agencies known as "A Federal Board of Maternal and Infant Hygiene" and "State Boards of Maternal and Infant Hygiene;" and

Whereas the establishment of new or competing health organizations, Federal or State, weakens the efforts of the existing legally constituted health agencies: Therefore be it

Resolved, That it is the sense of the Eighteenth Annual Conference of the State and Territorial Health Authorities with the United States Public Health Service that the objects of the Sheppard-Towner bill for the public protection of infant and maternal life be strongly indorsed; and be it further

Resolved, That it is the sense of this conference that the Federal administration of this act should be under the supervision and control of the Public Health Service, and in States, of the State health authorities; and that the sections of said bill relating to administration be changed to accord with these suggestions; and be it further

Resolved, That this resolution be laid before the Committees on Education and Labor of the House and Senate by a special committee representing this conference.

Dr. MCCORMACK. I believe it would be very much more forcible if that resolution were laid before the State and provincial health authorities. I move it be transmitted to the State and provincial health boards, and that the conference approve it now.

The resolution was adopted.

Dr. DRAKE. The third resolution is one offered by Dr. Rankin:

Resolved, That it is the sense of the Eighteenth Annual Conference of the State and Territorial Health Authorities with the United States Public Health Service that the objects of the Fess-Capper bill for physical education should be strongly indorsed; and be it further

Resolved, That it is the sense of this conference that the Federal administration of the said bill as it relates to the sanitation of school buildings and grounds and the detection and treatment of physical and mental defects and diseases of school children should be under the direction of the United States Public Health Service; and be it further

Resolved, That section 13 of the said bill should be amended so as to leave to the legislative bodies of the States the designation of the State machinery through which the provisions of the bill shall be carried into effect within the States, and that subsequent sections of the said bill be amended to accord with the change in section 13; and be it further

Resolved, That this resolution be laid before the Committee on Education and Labor of the Senate and Committee on Labor in the House by a special committee representing this conference.

Dr. Drake. Resolution No. 4 was offered by the committee on rural sanitation.

Whereas (1) over 53 per cent of the population of the United States is rural and the food supply for our whole Nation is dependent upon production in the rural districts; and

Whereas (2) physical defectiveness and preventable diseases have been found by extensive, careful studies to be as prevalent in our rural as in our urban population and only about 3 per cent of our rural population is served by local whole-time health departments approaching adequacy; and

Whereas (3) the promotion of rural health work is obviously of local, State, and National importance and, as has been demonstrated, may be secured to the highest permanent advantage by cooperative activities of local, State, and National governmental health agencies; and

Whereas (4) for the Public Health Service to proceed in a businesslike way in effecting its cooperative arrangements with State and local governmental health agencies for the promotion of rural health work a continuing appropriation is necessary; and

Whereas (5) the application of the principle of Federal aid extension to rural health promotion appears entirely logical, consistent with the theory and established practices of our system of government, and is urgently needed at this time: Therefore, be it

Resolved, by the conference of State and territorial health officers with the Public Health Service, that the members of this conference, individually and collectively, indorse the principles of legislation contemplated by the Lever rural health bill, introduced in the Sixty-sixth Congress, and agree to advocate such principles with a view to bringing about a nation-wide popular demand upon the Congress of the United States for such legislation.

The resolution was adopted.

Dr. Schereschewsky. Just one more subject to be discussed. After this subject the conference will be adjourned. The moving-picture machine is going to be moved back in here and the dental film of which Maj. Mitchell spoke will be shown a few minutes afterwards. The next subject is venereal-disease control by Dr. Pierce of the Public Health Service.

VENEREAL DISEASES.

(Dr. Pierce submitted the following report:)

Mr. Chairman, members of the conference: As it is quite late, I am not going to take up your time by going into details of venereal disease control work with which most of you are already familiar. Yesterday afternoon, last night, and to-day there have been special venereal disease conferences going on in another part of the building and at these conferences many details were discussed with the State venereal disease control officers. The most important matter to bring to your attention is in regard to the funds for carrying on the work in the States. The appropriation bill for the ensuing fiscal year will, no doubt, soon become a law and members of the committee have assured us of financial support for one more year on the same cooperative basis as has been in effect for the past two years. However, the amount appropriated for the year beginning July 1, 1920, will be approximately only 60 per cent of the amount which each State board of health received during the past year. It is very important for the success of the work to secure an appropriation of $1,000,000 for the fiscal year beginning July 1, 1921. In order to accomplish this purpose, two things will be necessary. First, Members of Congress must be able to realize that the work is of extreme importance and must know that the people of their State want this work continued. It is therefore important that each State board of health interest every local community in this problem and see that local communities bear their share of the expense and conduct the work in such a manner as to demonstrate its necessity. Second, it is necessary that each State board of health organise the work of its bureau of venereal disease control so that the amount appropriated by Congress will be expended during the year for which the appropriation was made.

There is at the present time a balance of approximately $116,000 remaining unexpended from the appropriation allotted to the States during the fiscal year ending June 30, 1919. For the current fiscal year there is nearly $400,000 that has not yet been disbursed by the Interdepartmental Social Hygiene Board. If this amount can be wisely expended, it is certainly advisable to increase the work of the State bureaus to the limit permitted by the appropriation. When representatives of the Public Health Service and the Interdepartmental Social Hygiene Board appear before the Appropriation Committee next winter, they should be able to show that the money appropriated has been not only expended but expended wisely and has accomplished results that are susceptible of demonstration.

Another subject which calls for discussion at this time is the fact that some accounting system is necessary in connection with the allotment of funds to State boards of health. There are certain necessary restrictions placed upon every appropriation by the Federal Government which must be observed. The Interdepartmental Social Hygiene Board is making every effort to reduce to a minimum the formalities required by the accounting system of the Government. Some of you will say that the formalities even reduced to a minimum are still quite considerable, but it must be borne in mind that there are certain laws, regulations, and comptroller's decisions by which all governmental agencies must be governed. A careful effort to observe the suggestions given by the Interdepartmental Social Hygiene Board will facilitate the work of accounting and reduce the amount of correspondence required to correct technical errors in vouchers submitted for payment.

The Division of Venereal Diseases is following the procedure outlined in the act creating the division—that is, to cooperate with State boards of health in venereal disease control work. One of the ways the division is helping State health officers and State venereal disease control officers is through furnishing monthly abstracts of literature relating to venereal disease control. Approximately 230 medical journals, reports from State departments of health, and other public documents are read each month by representatives of the division and the data of interest to those engaged in venereal disease control work is abstracted and tabulated. These abstracts are available to anyone desiring them, so long as the supply lasts.

I had intended presenting a paper to the conference on the value of statistical data that can be collected by each State bureau of venereal disease control. The paper, however, will not be read nor even a synopsis given except to emphasize a phase of the work which was discussed at the conference last night. On that occasion Dr. H. G. Irvine stated that it was the duty of all venereal disease control officers and others interested in this subject to utilize the opportunities presented from day to day of obtaining a record of as complete data as possible with regard to venereal infections. All of us must realize that until the present time one of the handicaps of the work has been the lack of reliable data. We have, for instance, but little data to show actually the percentage of infection of gonorrhea and syphilis, distributed as to sex, color, and occupation.

At the present time there are being treated in venereal disease clinics throughout the United States hundreds of thousands of cases of venereal infections each year. Within two or three years by giving close attention to this subject there could be collected detailed data in relation to all phases of venereal diseases on approximately

1,000,000 cases if clinic records were only kept and tabulated in such a manner that they could be studied. At the present time we, no doubt, waste much energy in the educational work for preventing venereal infections through lack of definite information which would enable us to focus our attention upon that part of the population most highly susceptible to venereal disease infection rather than proceeding, as at present we must proceed, by scattering our efforts broadcast. There is no way in which accurate data can be obtained except through the present venereal disease control organizations of the State boards of health.

I hope that when the venereal disease control officers return to their respective States they will bear in mind that aside from carrying on a generalized program they will impress upon the clinicians, nurses, and clerks in each venereal disease clinic their responsibility for the tabulation of data obtained in the clinic. Careful attention to this subject would soon result in a great mass of statistical material which could be studied and as the result of authentic information, our efforts could be concentrated, thereby promoting efficiency in the campaign for venereal disease control.

Dr. Creel. On several occasions the bureau has been very strongly urged to amend the United States quarantine regulations so as to make venereal diseases quarantinable and thus prevent their admission into the ports of the United States, and these recommendations included one for the visual inspection of genitalia. Ordinarily this would seem so impracticable as to hardly merit discussion, but the spirit of these crusaders against venereal disease is such that they do not admit that there is anything impracticable or impossible in the way of preventing the spread of venereal infection, and so you have to tell them why.

One of the suggestions made was that the regulations be applied to the entire personnel of the vessel, passengers and crew alike. Another suggestion was that the examination should apply only to the crew. Another, that the quarantine officer be given discretionary powers to examine those he might think were suspicious. The first proposition sounds radical. It is radical, but, as a matter of fact, it is perfectly consistent from a public health standpoint, since there is no reason to assume that the crew is exclusively affected with venereal disease and the passengers are not. Furthermore, the United States statutes provide that quarantine regulations shall be administered uniformly, and that is another objection to making any measure apply only to the crew. As to giving the quarantine officer discretionary powers, I think it is unjustifiable that an individual official should be obliged to exercise the part of censor.

From a legal standpoint, there is no obstacle to making venereal diseases quarantinable, since the United States quarantine laws give the Secretary of the Treasury power for providing regulations to prevent the introduction of any infectious or contagious disease, without any reservations whatsoever. It seems to me, however, that there are many grave administrative objections against including venereal diseases in the maritime quarantine regulations. No matter how expeditiously the practice may be carried out, it is bound to result in an enormous economic loss. The demurrage on transoceanic cargo carriers averages about $1 per ton per day and the majority of oversea carriers exceed 5,000 tons and are worth $5,000 per day; a great many of them exceed 10,000 tons and some of them 20,000 tons; so that, for every hour the ship is held up, there is considerable financial loss.

It has always been the policy of the Public Health Service to enforce powers of a discretionary nature only when there was some promise of advantage to be gained commensurate with the loss sustained by the enforcement of the regulation, and I believe that this principle should apply to any administrative procedure of a sanitary nature. For this reason, the United States quarantine regulations at present include only plague, yellow fever, typhus, cholera, and smallpox, for the reason that the first four are exotic diseases and, if introduced, would tend to become epidemic. In respect to smallpox, a number of types of this disease are very virulent and extraordinary measures are perfectly defensible. It would be difficult to defend a maritime quarantine against measles and the practice of holding up a ship for days at a time because of measles on board, when possibly there would be already existing in the port a number of cases of measles. The same principle applies to a great many other communicable diseases already existent in the United States and more or less endemic in the larger cities.

Aside from enforcing rigid quarantine against venereal disease, certain restrictive measures are already in effect. Under the immigration regulations, all aliens are subject to medical examination, and those that are found infected with venereal diseases are prohibited admission. The quarantine regulations provide that those communicable diseases that are not quarantinable shall, nevertheless, be reported to the local health officer, so that he may handle the case in the same manner as local infections of the same nature. This paragraph of the quarantine regulations requires that State health officers or other authorities shall be notified of any of the communicable, but not quarantinable, diseases sufficiently early to permit him to take action before the case is discharged from the vessel. In view of this, therefore, and considering the results that might be accomplished, it seems hardly justifiable to make venereal diseases quarantinable in the same way as cholera and typhus. There is a very prevalent opinion that sailors, as a class, are infected with venereal diseases. That was my opinion for a great many years, though I had never seen any reliable statistics on the subject. In the marine hospitals or in seamen's wards, it is true that a majority of the cases may be venereal, but this seems reasonable, since the sailor is generally a robust, healthy man, spending three-fourths of his time on the seas, not exposed to the ordinary communicable diseases to the extent that the landsman is, and by reason of his vocation is but little subject to organic lesions or degenerative diseases.

In order to form some estimate as to the prevalence of venereal diseases amongst seamen, the quarantine officer at San Francisco was requested to make a survey of a series of sailors on arriving vessels, and the chief medical officer at New York (Ellis Island) was given like instructions. Of a series of 2,000 cases examined at the quarantine station at San Francisco (including visual inspection of genitalia and preparation of slides) slightly over 2 per cent were found infected with gonorrhea or syphilis or chancroid. In New York Harbor, in a series of 6,000 cases given special examination, the percentage of venereal infection approximated 3 per cent. I do not doubt that there were a number of cases that got by, simply from the very fact that there are a number of difficulties that can not be overcome in making quick diagnoses; but, at the same time, these were the percentages and these figures would obtain if quarantine inspection were instituted in all cases for the detection of venereal diseases. The results would not be very satisfactory. It would seriously interfere with the movement of commerce, and, at the same time, would only prevent the addition of 1 or 2 per cent to the already existing venereal cases in the port. I think we can depend on the present regulations applicable to the medical examination of aliens to accomplish a great deal. Aside from this practice and the carrying out of the provisions of the quarantine regulations looking to the notification of local health officers, I think that more drastic regulations would hardly be justifiable.

In New York City the Public Health Service, in cooperation with the American Red Cross, has established an agency called the Seamen's Service Center, which, as its name indicates, is to render service to seamen. There is a growing sentiment in the United States for stimulating the growth of the American merchant marine. American ships must be manned, preferably by Americans. Anything that can be done to promote the welfare of the seamen is adding to national prosperity. At the Seamen's Service Center real help is given to seamen when ashore. They are not only sent to clinics but are furnished any assistance or advice that they may require. Temporary jobs are found for them, so that they may remain ashore and be treated, if necessary, and they are made to feel that they are not benificiaries of a social welfare organization, but are receiving only the advice and assistance to which they are entitled by virtue of their representing the United States. The work of the Seamen's Service Center is a plan worthy of imitation at all the other ports of the United States, and the development of this work will certainly have an important bearing on the personnel of the American merchant marine.

Surg. Gen. **Cumming**. We have cleaned the slate. Dr. Scherechewsky will take three minutes in which to speak about the initiation of a Nation-wide public health campaign.

FUTURE PLANS.

Dr. **Scherechewsky**. Gentlemen, we all want to get together and we want to improve the machinery for protecting the public health in the United States. How are we going to do it? One definite and concrete thing which we think might be done is this: We want to get together some day in the future all the persons in Washington who have to do with public health. Then we want to go before Congress and before our respective State legislators and get some action throughout the country. What do you think of the proposition? We are going to have the presidential election this fall. Most of the State legislators are going to meet in January. The new Congress will have the budget system. The circumstances will be favorable for us to get together and do something big. If you feel that the Public Health Service should take the lead in bringing the big convention here some time in September or October; we will work out a definite program by which we shall go ahead for our State, Federal, and local governments. What do you think of it?

Dr. **Welch**. I move to have a conference in November and indorse the proposition made by Dr. Scherechewsky.

Dr. **McCormack**. We are about to adjourn. I move you that this conference extend a vote of thanks to the Surgeon General and all who have contributed so greatly to the success of this conference and that we pledge them our loyal and undivided support and to do everything in our power to lessen the sickness and the death rate in our respective States.

(Unanimously carried.)

Dr. **Cumming**. For the officers of the Public Health Service and myself I want to express my sincere appreciation both for the vote and cooperation we have had. I have drawn a great deal of inspiration from this meeting and I only wish we were going to meet oftener. It would do me a great deal of good. I declare the meeting of the conference at an end.

STATE AND TERRITORIAL EXECUTIVE HEALTH OFFICERS.

Alabama.—Dr. S. W. Welch, State health officer, Montgomery.

Alaska.—Dr. L. O. Sloane, commissioner of health, Juneau.

Arizona.—Dr. George E. Goodrich, State superintendent of public health, Phoenix.

Arkansas.—Dr. C. W. Garrison, State health officer, Little Rock.

California.—Dr. Irving R. Bancroft, secretary State board of health, Sacramento.

Colorado.—Dr. R. L. Drinkwater, secretary State board of health, Denver.

Connecticut.—Dr. John T. Black, commissioner of health, Hartford.

Delaware.—Dr. L. S. Conwell, secretary State board of health, Dover.

District of Columbia.—Dr. William C. Fowler, health officer, Washington.

Florida.—Dr. Ralph N. Greene, State health officer, Jacksonville.

Georgia.—Dr. T. F. Abercrombie, commissioner of health, Atlanta.

Hawaii.—Dr. F. E. Trotter, president board of health, Honolulu.

Idaho.—Mr. P. L. Neil, commissioner department of public welfare, Boise.

Illinois.—Dr. C. St. Clair Drake, director of public health, Springfield.

Indiana.—Dr. J. N. Hurty, State health commissioner, Indianapolis.

Iowa.—Dr. Guilford H. Sumner, State health commissioner, Des Moines.

Kansas.—Dr. S. J. Crumbine, secretary State board of health, Topeka.

Kentucky.—Dr. A. T. McCormack, State health officer, Louisville.

Louisiana.—Dr. Oscar Dowling, president State board of health, New Orleans.

Maine.—Dr. Leverett D. Briston, State commissioner of health, Augusta.

Maryland.—Dr. John S. Fulton, State health officer, Baltimore.

Massachusetts.—Dr. Eugene R. Kelley, State commissioner of health, Boston.

Michigan.—Dr. Richard M. Olin, State health commissioner, Lansing.

Minnesota.—Dr. Charles E. Smith, jr., secretary State board of health, St. Paul.

Mississippi.—Dr. W. S. Leathers, secretary State board of health, Jackson.

Missouri.—Dr. George H. Jones, secretary State board of health, Jefferson City.

Montana.—Dr. W. F. Cogswell, secretary State board of health, Helena.

Nebraska.—Dr. Ira H. Dillon, chief bureau of public health, Lincoln.

Nevada.—Dr. S. L. Lee, secretary State board of health, Carson City.

New Hampshire.—Dr. Charles Duncan, secretary State board of health, Concord.

New Jersey.—Dr. Jacob C. Price, director of health, Trenton.

New Mexico.—Dr. C. E. Waller, United States Public Health Service, temporary commissioner of health, Santa Fe.

New York.—Dr. Herman M. Biggs, commissioner of health, Albany.

North Carolina.—Dr. W. S. Rankin, secretary and treasurer State board of health, Raleigh.

North Dakota.—Dr. C. J. McGurren, secretary State board of health, Devils Lake.

Ohio.—Dr. Allen W. Freeman, commissioner of health, Columbus.

Oklahoma.—Dr. A. R. Lewis, commissioner of health, Oklahoma City.

Oregon.—Dr. David N. Roberg, State health officer, Portland.

Pennsylvania.—Dr. Edward Martin, commissioner of health, Harrisburg.

Philippine Islands.—Dr. Vicente de Jesus, acting director of health, Manila.

Porto Rico.—Dr. Alejandro Ruiz Soler, commissioner of health, San Juan.

Rhode Island.—Dr. B. U. Richards, secretary State board of health and State registrar, statehouse, Providence.

South Carolina.—Dr. James A. Hayne, State health officer, Columbia.

South Dakota.—Dr. Park B. Jenkins, superintendent, Waubay.

Tennessee.—Dr. Olin West, secretary State board of health, Nashville.

Texas.—Dr. C. W. Goddard, State health officer, Austin.

Utah.—Dr. T. B. Beatty, State health commissioner, Salt Lake City.

Vermont.—Dr. Charles F. Dalton, secretary State board of health, Burlington.

Virginia.—Dr. Ennion G. Williams, State health commissioner, Richmond.

Washington.—Dr. John B. Anderson, State commissioner of health, Seattle.

West Virginia.—Dr. Richard T. Davis, commissioner of health, Charleston.

Wisconsin.—Dr. C. A. Harper, State health officer, Madison.

Wyoming.—Dr. C. Y. Beard, secretary State board of health, Cheyenne.

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 112
DECEMBER, 1921

PRELIMINARY STATISTICAL REPORT OF THE OREGO STATE SURVEY OF MENTAL DEFECT, DELINQUENCY, AND DEPENDENCY

CONDUCTED BY
THE UNIVERSITY OF OREGON
UNDER THE DIRECTION OF THE
UNITED STATES PUBLIC HEALTH SERVICE
AT THE REQUEST OF THE
LEGISLATURE OF THE STATE OF OREGON

1920

Surgeon CHESTER L. CARLISLE (Reserve)
United States Public Health Service
Director of Survey

HARVARD UNIVE
SCHOOL OF MED [illegible]

WASHINGTON
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1922

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Hugh S. **Cumming,**
ed States Public Health Service.

THE OREGON STATE SURVEY OF MENTAL DEFECT, DELINQUENCY. AND DEPENDENCY.

ORIGIN, OBJECT, SCOPE, AND METHODS.

Dr. Chester L. Carlisle, United States Public Health Service, Director.

The Oregon State survey was initiated by the interest of the citizens of Oregon in promoting the public health. Through their representatives in the State legislature in 1919 it took form as senate joint resolution 28, in which it was enacted: "That the University of Oregon is hereby granted authority to make such survey, and * * * to report the result of its study with recommended legislation to * * * the next regular legislative assembly, with the understanding that the State will be asked for no appropriations for the purpose."

Oregon, central State of the Pacific group, lies between 42° and 46° 15″ north latitude and 116° 45″ and 124° 30″ west longitude. It is bounded on the south by California and Nevada, on the east by Idaho, on the north by Washington, and on the west by the Pacific Ocean.

The area of Oregon is 96,699 square miles, considerably more than 1,000 square miles being water surface. The State has 300 miles of coast line, exclusive of indentations. The width east and west is about 350 miles, the length north and south approximately 275 miles.

Oregon was admitted into the Union February 14, 1859, and had at that time a population of about 53,000. Population 1920, 783,285.

The University of Oregon, through its extension division extended an invitation, indorsed by the State board of health, to the United States Public Health Service to act as director of the survey requested by the legislature.

Without funds for a paid staff and confronted by the task of adequately covering 96,699 square miles of territory, containing 36 counties, some of which are about the size of Connecticut, the director of the survey saw that in just such a situation lay the opportunity for developing a State-wide campaign in mental, physical, and social hygiene. Plans were accordingly laid to enlist the aid of every public-spirited citizen.

To the Hon. Ben W. Olcott, governor of the State, the director of the survey begs to render the thanks and appreciation of the United States Public Health Service and the University of Oregon for his constant interest in the survey and for his official permission for the use of the State seal upon the certificates, carrying the seal of the University of Oregon, over the signiture of the United States Public Health Service, which were sent to over 10,000 citizens of special training in the State. These certificates requested the recipient to act as a special voluntary assistant from a sense of high citizenship and patriotism, serving without remuneration.[1]

Thus was "enlisted" the aid of every physician, judge, lawyer, clergyman, nurse, educator, teacher, and other individual citizen known to be interested in community welfare work; and also every State, county, city, and village official, and every officer and member of all social welfare and philanthropic groups of the State, including the local chapters and branches of the American Red Cross.

These special voluntary assistants were asked to write to the headquarters of the survey for data cards upon which they were to record the facts of mental or physical defect, delinquency, dependency, or retardation in school work, coming under their own observation and return the information to the director of the survey for analysis and tabulation. The survey cards upon which the data were recorded were arranged by the director to take care of any possible combination of medico-psychological-sociological symptoms which might be found in any one individual.

The survey was further assisted by the voluntary contributions of time and labor by a number of especially trained observers who have made intensive studies as to the incidence of mental defect in delinquents, dependents, and in retarded pupils in school.

Thus was inaugurated the first State-wide, cooperative citizen survey in the fields of mental, physical, and social hygiene, in the history of the world. This preliminary statistical report and the full report of the Oregon State survey to be published later by the University of Oregon are the answers as to whether the American people can undertake such a project and carry it to success. Oregon, pioneer, fighter and leader, has blazed a new trail, and opened up a tremendous vista for further citizen cooperation and usefulness in the whole field of public welfare.

The director, on the part of the Oregon State survey, wishes to express his deep appreciation for the constant cooperation and active assistance of all the various State, county, and city officials; all the heads of institutions, State, county, and private; all the various officers and members of welfare groups; all the local chapters and branches of the American Red Cross; and all those teachers and other public-spirited citizens who returned information and survey record cards.

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[1] See appendix for the wording of this certificate.

The State of Oregon is particularly indebted to P. L. Campbell, B. A., LL. D., president of the University of Oregon, for his broad vision, hearty support, and constant interest in all the various social and technical aspects of the Oregon State survey.

The thanks of the survey are also extended to the whole faculty of the extension division of the University of Oregon, under which the whole project was carried on, especially to—

Earl Kilpatrick, B. A., director extension division, special survey contributor, under whom all technical work of the survey was produced.

John C. Almack, M. A., assistant director extension division, special survey contributor of historical-economic material.

Alfred Powers, B. A., assistant director extension division, special survey contributor for publicity.

Mozelle Hair, B. A., secretary extension teaching, extension division, and special research investigator in child hygiene, pupil retardation, and delinquency for the survey.

L. C. Douglass, B. A., instructor in education, extension division, special research investigator in child hygiene and education for the survey.

Mary E. Kent, B. A., secretary to the director and executive secretary for the survey:

The success of the survey depending largely upon the exactness of special research studies made for it, the director wishes to make particular acknowledgment of the great value of the work done for the citizens of Oregon by the following members of the faculty, who, in addition to those mentioned above, have made actual contributions to the survey:

B. W. De Busk, Ph. D., professor of education, special research investigator in educational psychology for the survey.

C. A. Gregory, Ph. D., professor of education, special research investigator in delinquency for the survey.

Eric W. Allen, B. A., dean of school of journalism, special survey contributor for publicity.

Ruth Montgomery, B. A., fellow in education, special investigator in juvenile delinquency and juvenile and adult dependency for the survey.

Giles M. Ruch, M. A., former principal of university high school, special survey contributor for pupil retardation.

Philip A. Parsons, Ph. D., director Portland School of Social Work, special survey contributor for coordination of social workers.

Franklin Thomas, Ph. D., former director Portland School of Social Work, special survey contributor for coordination of social workers.

Celia V. Hager, M. A., instructor in psychology, special survey contributor for coordination of social workers.

To the following members of the faculty the director wishes to make grateful acknowledgment for their constant support and specific official interest:

John Straub, M. A., Lit. D., dean of men.

Elizabeth Fox, B. A., dean of women.

Colin V. Dyment, B. A., dean college of literature, science, and arts.

R. B. Dillehunt, B. S., M. D., dean of school of medicine.

H. D. Sheldon, Ph. D., dean of school of education.

E. C. Robbins, Ph. D., dean of school of commerce.

William G. Hale, B. S., LL. B., dean of school of law.

H. R. Douglass, B. A., director university high school.

To the hundreds of the special voluntary assistants of the survey, throughout the length and breadth of the State, the director wishes to say, in acknowledging their support, that the survey does not merely thank them for their help; rather, the survey realizes that without their help it could never have existed. It is therefore with particular pleasure that the director returns especial thanks to the following citizens of Oregon who, by their interest and voluntary assistance, have been leaders in this great movement in mental, physical, and social hygiene:

Jacob Kenzler, judge of court of domestic relations, Portland, special survey contributor for domestic relations problems.

S. C. Kohs, Ph. D., psychologist court of domestic relations, Portland, special survey contributor for the court.

Ida M. Manley, director of special classes, Etna School, Portland, special research investigator for the survey in retardation of school children in city schools, and coordination of teachers.

A. R. Gephart, secretary public welfare bureau, Portland, special survey contributor for coordination of social workers.

Millie R. Trumbull, secretary board of inspectors of child labor, special survey contributor for children in industry.

C. H. Gram, commissioner bureau of labor, special survey contributor for status of Chinese and Japanese in Oregon.

Sam A. Kozer, secretary of state, for official reports.

O. P. Hoff, state treasurer, for official reports.

R. B. Goodin, secretary Oregon State Board of Control, for official reports.

David N. Roberg, M. D., State health officer, for official reports.

Andrew C. Smith, M. D., acting director State board of health, for official reports.

J. A. Churchill, State superintendent of public instruction, for authorization of the State survey in the Oregon public schools, and for official reports.

William D. Wheelwright, chairman child welfare commission, for official reports and information on child hygiene.

Mary Brownell, R. N., Lane County public health nurse, for assistance in the intensive study of Lane County.

Harriet H. Heller, secretary child welfare commission, for official reports.

Elizabeth Burrows, executive secretary Baker County Chapter, American Red Cross.

The Right Reverend Walter T. Sumner, B. S., D. D., bishop of the Oregon diocese of the Episcopalian Church.

The Most Reverend Alexander Christie, D. D., archbishop of the Oregon diocese of the Roman Catholic Church.

The Reverend Edwin V. O'Hara, LL. D., superintendent of Roman Catholic schools.

A. E. Clement, State program director Salvation Army.

To the following officers in charge of State institutions for affording the survey the research facilities of the institutions and for official reports:

R. E. Lee Steiner, M. D., superintendent Oregon State Hospital.

W. D. McNary, M. D., superintendent Eastern Oregon State Hospital.

L. H. Compton, warden Oregon State Penitentiary.

J. N. Smith, M. D., superintendent State institution for feebleminded.

L. M. Gilbert, superintendent Oregon State Training School for Boys.

Clara C. Patterson, superintendent Oregon State Industrial School for Girls.

G. C. Bellinger, M. D., superintendent Oregon State Tuberculosis Hospital.

Mrs. Sadie Orr-Dunbar, secretary Oregon State Tuberculosis Association.

J. W. Howard, superintendent Oregon State School for Blind.

E. S. Tillinghast, superintendent Oregon State School for Deaf.

To the 200 or more editors of Oregon who assisted the citizens of the State by the gratuitous publication of survey publicity material, and particularly to the following, the State survey is indeed glad to make its grateful acknowledgment:

E. B. Piper, editor of the Oregonian.

B. F. Irvine, editor of the Oregon Journal.

F. L. Boalt, editor of the News.

J. E. Wheeler, editor of the Portland Telegram.

Frank Jenkins, editor of the Eugene Register.

C. H. Fisher, editor of the Eugene Guard.

E. B. Aldrich, editor of the East Oregonian, Pendleton.

Harry Kuck, editor of the Tribune, Pendleton.

Students of the University of Oregon, editors of the Oregon Emerald.

The Oregon State Survey has collected facts relating to mental and physical defect, delinquency and dependency for every county in the State. The director has received many suggestions as to social needs in the various sections of the State and ways to remedy them. The combined consensus of opinion of many citizens as to satisfactory methods of dealing with potential and actual problems of social inadequacy are embodied under the statutory recommendations of the survey, to which your careful attention as representative of the citizens of Oregon is respectfully invited.

The present cost to the taxpayers which defective, inefficient, inadequate, delinquent, or dependent conduct entails on every man, woman, and child in Oregon is, in a word, the bulk of all State, county, and city taxes which you are paying for the upkeep of police, jails, penitentiaries, courts of criminal jurisdiction, sheriffs' duties, poor relief, hospitals, institutions, and homes for the diseased, defective, disordered, delinquent, or dependent of all types, including also your charitable donations of shelter, medicine, money, food, or clothing.

High standards in public health, public welfare, community efficiency, and individual citizen health and happiness are attainable by the simple method of determining fundamental factors causing sickness and subnormal conduct, and once so determined, adequately handling the proposition through a strictly modern, efficient and adequate State system of control of all matters relating to the public health and public welfare, both as to communities and to all types of public and private institutions.

CHESTER L. CARLISLE, M. D.,
United States Public Health Service,
Director, Oregon State Survey.

DECEMBER 19, 1920.

Dr. HUGH S. CUMMING,
Surgeon General, United States Public Health Service,
Washington, D. C.

DEAR SIR: I have followed with great interest during the past year the work of Dr. Chester L. Carlisle, of the United States Public Health Service, in directing the Oregon State survey of mental defect, delinquency, and dependency undertaken by the University of Oregon, under resolution of the State legislature and in cooperation with the United States Public Health Service.

Dr. Carlisle's method—that of a volunteer citizen survey—has proven a most interesting and successful experiment, the first of its kind undertaken, and has been conducted with great skill and efficiency. The results are sure to prove of marked value to the State.

The survey indicates very clearly the mutual interdependency of delinquency, dependency, and mental defect, and points toward a closer correlation of the agencies employed in meeting the problems in these fields. How this correlation can best be effected is a matter to be considered and determined by the proper State authorities.

Dr. Carlisle in his report suggests the use of certain departments of the university for research purposes, utilizing the data which might be supplied by the various State agencies dealing with the delinquent, the defective, and the dependent. I am personally heartily in sympathy with this suggestion, and I feel sure that the departments named would welcome the opportunity to render any service within their power in helping the State solve the grave questions which are presented by these State wards.

Permit me to express the deep appreciation felt by the university of the generous cooperation given by the United States Public Health Service in this survey, and also of the very able work done by Dr. Carlisle in conducting it.

With highest regard, I have the honor to remain,

Very sincerely and respectfully, yours,

P. L. CAMPBELL,
President of the University of Oregon.

COURT OF DOMESTIC RELATIONS, MULTNOMAH COUNTY.

By the Hon. JACOB KANZLER, Judge.

[Including Report of Psychological Laboratory, by S. C. Kohs, Ph. D., psychologist.]

Statement prepared by the court for the Oregon State survey:

Chief probation officer, T. J. Hewitt.

Child-caring institutions in Multnomah County: Albertina Kerr Nursery, Waverly Baby Home, Boys' and Girls' Aid Society, Frazer Detention Home (part of Court of Domestic Relations), The Louise Home, Salvation Army Rescue Home, House of the Good Shepherd, Florence Crittenton Refuge Home, and Elizabeth Cottage for Feeble-minded.

County nurse, Miss Ruth B. Young.

Approximate number of child cases handled by the court of Domestic Relations between Oct. 1, 1919, and Oct. 1, 1920:

Delinquent	1,300
Dependent	500
Adoptions	125
Total	1,925

Approximate number of child cases, including second and third hearings:

Delinquent	1,450
Dependent	550
Adoptions	125
Total	2,125

Disposition of cases:

Number left with parents or guardians	1,675
Adopted	125
Committed to institutions (still in institutions)	125
Miscellaneous	200
Committed to organizations:	
Boys' and Girls' Aid Society—	
Temporary	92
Permanent	10
Pacific Coast Rescue and Protective Society, temporary (approximate)	35
Committed to institutions:	
Girls' Industrial School, permanent	7
Boys' Training School, permanent	18
School for Feeble-minded, permanent	60
State Tuberculosis Hospital, temporary	1
Cedars (quarantined—subject to court when released)	46
Frazer Home, temporary	281
House of Good Shepherd, temporary	57
Florence Crittenton Home, temporary	5
Salvation Army Home, temporary	11
Christie Home, temporary	6
St. Agnes's Baby Home, temporary	5
St. Mary's Home for Boys, temporary	6
Others, temporary	4

Report of psychological laboratory—Number examined for intelligence between August, 1919, and July 31, 1920:[1]

Very superior	1
Superior	6
Average normal	59
Dull normal	62
Border zone	57
Feeble-minded	123
Potential feeble-mindedness	1
Total	[2] 309

Mental disorders:

Dementia præcox (hebephrenia)	1
Psychopathic constitution	3
Epilepsy	2
Sexual psychopathy	1
Total	7

---

[1] Seventy-nine per cent of these cases show mental dulling or mental defect; 40 per cent of these cases show actual mental defect—Director of Oregon State survey.

[2] Three of these being retests, the list includes 306 individuals.

INTENSIVE STUDY OF DELINQUENCY.

By Prof. C. A. Gregory, M. A., School of Education, and Miss Mozelle Hair, B. A., Secretary of Extension Teaching University of Oregon, Special Field Investigators.

Psychometric tests were given to 200 delinquents, inmates of the Oregon State Penitentiary, by permission of the warden. At the time the survey was made there was a total of 270 prisoners, of which one was a women, but it was not possible to give the tests to all, as some were on the grounds or in the shops or for other reasons were not available.

The figures of this report are based upon the results of the Army alpha test. The work was done in the large dining hall where the men sat on benches at long tables. They were crowded in closely together and it was impossible to prevent absolutely all conversation. Test papers were distributed to all, but only 123 cooperated. The papers of these individuals are the ones included in this report. It is impossible to tell whether or not the work represents the man's best efforts in every case, but it is believed that the papers turned in represent the work of the better class of prisoners. The percentage of mental defect is therefore all the more striking.

The results of the Army alpha are for convenience stated here in terms of the Terman intelligence quotient, which indicates the individual's mentality, with due consideration for his actual age.

	Number of men.	Intelligence quotient.	Psychometric score.
Superior mental ability	10	Above 110	From 112 to 120.
Normal or average mental ability	50	90 to 110	From 90 to 110.
Subnormal mental ability	24	80 to 90	From 80 to 90.
Border-line mental ability	12	70 to 80	From 70 to 80.
Mental defect or feeble-mindedness	27	Below 70	From 70 to 53.
Total	123		

Of these 123 men it is seen that 50 individuals, or 40 per cent, are of average intelligence; 10 individuals, or 8 per cent, are above the average; 63 individuals or 51 per cent, show distinct mental dulling; 27 individuals or 22 per cent, show actual mental defect. None of this last group has a greater mental ability than a child of 12 years or under, and being now of adult years will never reach an adult mental level of development.

In the investigation of these prisoners no attempt was made to ascertain or to include those cases of affective deviation which so often is found to account for odd, antisocial, or delinquent conduct, particularly among individuals of average or even superior quantitative intelligence where it is obvious that the delinquent conduct was not dependent upon mere feeble-mindedness as usually considered.

Neither has any attempt been made to study the delinquent conduct of the 123 prisoners in the light of possible psychoses (insanity), psychonouroses (including hysteria), constitutional inferiority, or epilepsy. This study demonstrates the one outstanding fact that in the State penitentiary (a specific group of delinquents of all types) about one-fourth of the men examined show gross mental defect while over one-half show mental dulling or mental defect and are distinctly below the average of mental capacity. Odd, inefficient, antisocial, delinquent conduct (crime) usually means an individual who is suffering from a specific form of handicap.

Mental dulling or mental defect was found to be present in over half of the delinquents (criminals) in the Oregon State Penitentiary.

INTENSIVE STUDIES IN JUVENILE DELINQUENCY.

By RUTH MONTGOMERY, B. A., Graduate Assistant in Education, University of Oregon, Special Field Investigator.

OREGON STATE INDUSTRIAL SCHOOL FOR GIRLS.

Scale used: Standford-Binet, United States Army type.

Census, girls (at time of survey, 12 on parole, 10 out of institution, leaving 33 available for special examination)	55
Results of psychometric examinations:	
Normal intelligence capacity, intelligence quotient above 90	2
Subnormal, intelligence quotient between 80 and 90	8
Border-line, intelligence quotient between 70 and 80	15
Mental defective, intelligence quotient below 70	8
Total	33

Eight cases, or 24.2 per cent, showed definite mental defect.

OREGON STATE TRAINING SCHOOL FOR BOYS.

Scale used: Stanford-Binet, United States Army type.

Psychometric examinations were made on 146 of the 168 boys in the State training school. These boys are sent to this school because of thievery, truancy, refusal to accept parental management, and other forms of delinquency.

A large percentage of these boys (age from 10 to 21 years) are either mentally defective or of subnormal or border-line intelligence.

The boys are taught tailoring, farming, shoemaking, and other trades, in addition to grammer-school subjects and physical training. They are also permitted to study music, but must pay for their own lessons.

The school is run on a military plan, which has been a great success in handling such a large number of boys. As they all live in the same building, segregation of types is not complete.

The table shows the result of the psychometric examination:

	Number.	Per cent.
Supernormal	3	2.0
Average normal	27	18.5
Subnormal	37	25.3
Border line	43	29.4
Mental defect	36	24.6
Total	146	100.0

One hundred and sixteen boys, or 79.4 per cent, show mental dulling or mental defect; 36 boys, or 24.6 per cent, show actual mental defect.

THE MENTALLY DEFECTIVE CHILD IN INDUSTRY.

By Mrs. Millie R. Trumbull, Secretary Industrial Welfare Commission, Special Voluntary Assistant.

Some day the employers of the United States will awaken to a sense of the great economic loss sustained through the mental defective worker. In no place is he a greater menace than in the field of industry. Seen through the eyes of the child labor bureau in Portland, he presents one of the biggest factors in the labor turnover—on the accident list—and in the great mass of irresponsible workers which tries the soul of every employer. He is no sooner taught the beginning of a process, than he decides to change his employment. Back to the bureau he comes and the pathetic performance is repeated until be is past tbe permit age. He then becomes the incompetent adult.

If the child is under 16, the situation is under control, as his low school grade forbids the issuing of a permit, but as soon as he becomes 16 he (or she, as the child is often a girl) becomes an industrial misfit and the tragedy begins.

In some cases they have been "passed on" in their grades until we find them with a certificate of graduation. This is really a hindrance instead of a help, as the permit gives such graduates a wider latitude for work; thus the disheartening process is intensified by the high-grade mental defective who is industrially incompetent.

Some day employers will demand psychological examinations of workers so that time, effort, and their consequent cost in money will not be wasted.

There are cases on record of children who have changed jobs every two or three weeks, and whose permits are written all over their bare spaces with names of places of employment. There is but one answer to the why—"Below grade mentally." We had the case during the summer of a boy (Italian) whose family we had known for years as of low-grade mentality. When he lost his job he would be brutally beaten by his father. Finally he came to the office for a change of permit to an employment forbidden a boy of his age. His distress when refused was so keen that we suspected the reason and told him to bring his father in. The father came and he was plainly told that if he touched the boy again on account of loss of a job terrible things would be done to him. We were able to impress his feeble mind by threats. He was warned, too, that the great invisible eye of the board of inspectors of child labor would be watching him. The next time the boy came back he was cheerful; he had not been beaten since.

Another case illustrating the value of "industrial diagnosis." A boy was known to be low grade mentally and made application for a permit as rivet passer in the shipyards during the war. We held the case until we could inform ourselves more definitely as to his school grade. The attendance officer gave as his dominating trait a violent, ungovernable temper.[1] We called up the employment manager of the shipyards and told him about the boy—that in a sudden fit of rage he was likely to throw the white-hot rivet at a fellow workman. The telephone fairly sizzled with his emphatic direction to "keep him away from us." We had most cordial cooperation in the enforcement of the child-labor law in that yard after that.

Another case: A girl, very pretty, well mannered, came for a permit to work in a soft-drink parlor run by a Greek. We know the place, the neighborhood, and the mentality of the girl—of such a low grade that she would have succumbed very easily to the evil influences of the place. The permit was refused.

The juvenile hobo is almost always a boy of low-grade mental caliber. He goes from one lumber camp and logging mill to another, mixing with mental derelicts among the adults. He becomes physically contaminated, and the degradation of the race goes on unchecked.

In the files of the child labor bureau in Portland can be found the record of almost every youthful criminal who has been sent to the

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[1] Note by Chester L. Carlisle, M. D., director Oregon State survey: Unstable emotional balance—tantrums, rages, and odd conduct—such as this boy shows is typical of that found in cases showing essentially affective deviation (in contradistinction to inefficient conduct based on uncomplicated lack of quantitative intelligence capacity). The "affect" is that part of our "thinking" which puts the force, or will to do, behind our ideas. Thus conduct is produced. In other words, this is the behavior of the individual. Conduct is the sum total of mental and physical output of any person, colored by environment. (Notice affective deviation under mental causes of retardation in school children, teachers' referendum charts.) There are other types of mental disease, defect, or disorder which may produce odd or inefficient conduct similar to that of this boy in the shipyard, aside from either simple affective deviation or lack of quantitative intelligence capacity. These are, notably, epilepsy, also certain forms of nervous disorders and incipient insanity (psychoses). All of these varying symptoms of abnormal conduct emphasize the value of making mental as well as physical examinations of every person who enters industry. The type of work which is best suited to the actual make-up of the individual may thus be determined. Happiness through contentment of the individual, reduction of losses to the employer, and safety to the public will be sure to follow such procedure.

State training school and later to the penitentiary during the last 15 years. The typical case is found to be low grade in school work and pronounced a difficult child by the teacher. Probably he was turned out of his classes to go to work because he was a nuisance in school. He then became a greater nuisance in industry, and the line of least resistance attracted him, with the State training school for delinquents at the end of it.

When the epidemic of auto stealing broke out we could go regularly to our files and find the boy's card. Invariably it showed a low school grade for his age. He was one of the retarded children overage for his school grade. The sixteenth year limit and eighth grade qualifications for permit became law in 1919. We have had a large harvest of defective delinquents who became so through a wrong diagnosis four or five years earlier, before the public recognized the true meaning of retarded school work and inefficient conduct-mental defect.

Two years ago we tabulated the commitments to the training school as shown on our files—65 to 70 per cent were boys who had gone to work on a child-labor permit. Of these, 50 per cent were shown by a later psychological examination at the State training school to be mental defectives.

We give herewith the list of children between 16 and 18 who have gone to work on low-grade (part-time or night school) permits since September, 1919, to December 20, 1920, issued by the Portland office.

Age.	Number of cases.	Grade in school.						Total.
		3	4	5	6	7	8	
1919.								
Boys:								
16	99	1	3	5	28	68	88	193
17	94							
Total	193							
Girls:								
16	81	......	......	4	21	55	73	153
17	72							
Total	153							
1920.								
Boys:								
16	121	1	4	14	35	136	219	409
17	288							
Total	409							
Girls:								
16	89	......	1	3	23	77	132	236
17	147							
Total	236	......	......	......	......	......	......	991

Note the age of these children and the school grade they are in.

One word more. We have been in the work long enough to have seen the inadequate worker in industry—and inadequacy usually means mental defect—multiply. We have applicants to-day of the same (or lower) grade of mentality as the parents who were among our first working children in 1903. The same struggle, multiplied as to numbers, itensified as to problems, goes pathetically on.

We will remain helpless unless the employers take a hand and insist upon:

First. A psychological chart with each employee.

Second. A demand on the State legislature that segregation must be established for all those below a certain grade of mentality—with sterilization as the price of freedom for all defectives in the communities. There is work these individuals can do, but not where there is dangerous machinery. Either in our schools or in our child-labor office the analysis must be made, if we would relieve industry of its most expensive incubus.

DEPENDENCY—SPECIAL TYPES.

[County totals for individuals in institutions.]

(Tables compiled through the courtesy of reports and other information transmitted by the Oregon State Board of Control, the superintendents of all the State institutions and the officers in charge of private institutions and agencies receiving public funds.)

The individuals listed in these tables are either cases of mental or physical defect, disease, or disorder who have by reason of such handicaps become dependent, or else are individuals who by reason of inefficient, antisocial conduct have been classed by the courts or by society as delinquents of varying degree, all of whom, on account of abnormal behavior, it was necessary to remove from community life. All of these individuals are now, or recently have been, dependents in State institutions, or in private institutions receiving public funds. Inmates of village, city, and county jails, also inmates of county poor farms, are not included in this table. Inmates of jails appear in the figures for delinquency in the county community tables. Inmates in poor farms appear in the special table relating specifically to the problem of the dependent poor.

Various divisions of public welfare work in Oregon in so far as they relate to institutional care for the biennium ending Sept. 30, 1920.

[Total number cared for in each institution.]

Counties.	Division of mental hygiene.		Division of delinquency.		
	Both State hospitals for the insane.	State School for Feeble-minded.	Oregon State Training School for Boys.	State Industrial School for Girls.	Oregon State Penitentiary.
Baker	98	13	13	1	42
Benton	40	15	6	8	9
Clackamas	138	32	24	5	12
Clatsop	144	14	8	5	16
Columbia	59	12	12	....	7
Coos	94	21	20	1	11
Crook	23	2	3	....	6
Curry	16	....	1	....	....
Deschutes	11	....	5	1	1
Douglas	94	11	11	6	36
Gilliam	17	1	....	....	6
Grant	13	....	3	....	5
Harney	17	1	1	....	5
Hood River	15	8	3	1	14
Jackson	88	15	11	3	11
Jefferson	6	1	....	1	4
Josephine	35	12	1	....	9
Klamath	36	....	1	....	10
Lake	15	....	1	....	8
Lane	131	27	27	8	25
Lincoln	12	8	2	....	10
Linn	101	17	6	1	11
Malheur	44	6	2	6	26
Marion	381	51	27	14	20
Morrow	15	1	1	....	2
Multnomah	1,604	244	186	39	223
Polk	43	9	8	....	7
Sherman	12	2	....	....	1
Tillamook	26	4	....	2	8
Umatilla	152	12	2	....	58
Union	69	7	16	2	40
Wallowa	25	3	1	....	6
Wasco	78	11	10	1	27
Washington	102	26	12	3	10
Wheeler	10	1	3	....	3
Yamhill	95	14	9	1	15
Unknown	....	2	....	....	....
Waiting list	....	53	....	....	....
Total	3,859	656	436	109	704

Various divisions of public welfare work in Oregon in so far as they relate to institutional care for the biennium ending Sept. 30, 1920—Continued.

Counties.	Division of private institutions—private institutions receiving public funds.	Division of public health—Oregon State Tuberculosis Hospital.	Division of special education.		Division of military affairs—Soldiers' Home.
			State school for blind.	State school for deaf.	
Baker		3		3	6
Benton		2		3	4
Clackamas	743	11	3	6	10
Clatsop		10	1	1	
Columbia		5		2	6
Coos		16		3	6
Curry					2
Deschutes		2		1	
Douglas		2	1	6	73
Gilliam		1			
Grant		1			
Harney					2
Hood River		2		1	
Jackson		8	2	2	26
Jefferson					2
Josephine		1		1	18
Klamath		2	1	3	8
Lake					1
Lane		11	1	12	28
Lincoln		1		3	2
Linn			1	14	10
Malheur		1			1
Marion		49	12	27	14
Multnomah	2,418	135	17	26	78
Polk		8	2	5	6
Sherman		1	1		
Tillamook		1	7	1	4
Umatilla		4	3	1	3
Union		3		2	12
Wallowa		3		2	
Wasco		7		3	2
Washington	409	4		6	8
Wheeler			1		
Yamhill		5	3	2	8
Total	3,570	306	58	136	340

Multnomah County Poor Farm not included here. See special article relating to poor farms for entire State.

It is to be noted that the odd conduct commonly associated with psychoses (insanity) is more generally recognized by the public as needing specific care as a symptom of abnormality than is the odd or antisocial conduct of delinquency, it therefore follows that the number of insane for each county cared for in hospitals follows the ratio of county population much more closely than does delinquency.

POOR FARMS AND OUTDOOR RELIEF.

By Ruth Montgomery, B. A., Graduate Assistant in Education, University of Oregon, Special Field Investigator.

The State of Oregon has 36 counties, 18 of which maintain poor farms for the care of the totally dependent poor. These counties were all visited as part of the Oregon State survey and data obtained upon the local problem of dependency in each county.

The other 18 counties in the State maintain their totally dependent poor by boarding them out in private homes, or by furnishing them aid in the form of cash allowances, fuel, rent, or supplies. Several of the counties that do not maintain a regular poor farm send their totally dependent persons to the Multnomah County Farm. Wasco County and Clatsop County also maintain poor from other counties.

The figures for outdoor relief in the following table may be taken as fairly typical of all Oregon counties in the several geographically different sections of the State.

Dependency in Oregon divides itself into four classes: Total dependents maintained in poor farms; total dependents boarded out with individuals; partial dependents given county aid; widowed mothers receiving regular pensions.

Following is a list of the counties having poor farms, showing the number found in poor farms; the number of inmates of farms found to show some degree of mental defect, disease or disorder, a fact which, no doubt, is the underlying cause for their dependency; the average number of mothers who receive compensation each month; and the average number who receive outdoor relief from the county each month.

Table showing poor farms in the State of Oregon.

RESIDENTS OF COUNTY POOR FARMS.

	Number of inmates.[1]			Number showing mental defect, disease, or disorder.		
	Male.	Female.	Total.	Male.	Female.	Total.
Baker	11	0	11	2	0	2
Coos	7	0	7	2	0	2
Clatsop	19	3	22	7	1	8
Douglas	7	1	8	4	0	4
Grant	6	0	6	2	0	2
Harney	2	0	2	0	0	0
Josephine	12	0	12	3	0	3
Jackson	14	1	15	4	1	5
Klamath	6	1	7	3	1	4
Lane	10	3	13	4	2	6
Linn	13	0	13	6	0	6
Marion	18	0	18	9	0	9
Multnomah	232	46	278	[2] 97	11	108
Polk	5	0	5	3	0	3
Umatilla	14	0	14	7	0	7
Union	5	0	5	1	0	1
Wasco	8	5	13	3	2	5
Yamhill	0	2	2	0	0	0
Total	389	89	451	157	18	175

[1] These figures are an approximate monthly average for summer months. It increases approximately 7 to 8 per cent in winter.

[2] These figures conform to the ratio for mental defectives ascertained by special examinations made in poorhouses outside of Multnomah County.

Table showing poor farms in the State of Oregon—Continued.

OUTDOOR RELIEF.

	Average number widow's pensions per month.	County aid in the community—average per month (individuals).		Total dependents indoor and outdoor relief.
		Male.	*Female.*	
Baker	28	5	5	10
Coos	37	(3)	(3)	42
Clatsop	9	(3)	(3)	14
Douglas	12	12	7	19
Grant	6	(3)	(3)	12
Harney	9	6	6	12
Josephine	21	13	20	33
Jackson	23	20	18	38
Klamath	35	5	12	17
Lane	30	(3)	(3)	20
Linn	37	(3)	(3)	14
Marion	16	(3)	(3)	60
Multnomah	141	(3)	(3)	20
Polk	19	(3)	(3)	(3)
Umatilla	20	(3)	(3)	11
Union	31	4	20	24
Wasco	24	(3)	(3)	63
Yamhill	36	5	13	18
Total	534			427
Total persons dependent in any form				1,412

[3] Detailed information not available.

AN INTENSIVE STUDY OF DEPENDENTS WITH SPECIAL HANDICAPS, OREGON STATE SCHOOL FOR THE BLIND.

By Ruth Montgomery, B. A., Graduate Assistant in Education, University of Oregon.

Census blind children at time of survey	33

It is found that the blind have no difficulty in interpreting and responding to psychometric tests so far as the blindness itself is concerned. This is due to the fact that so long as hearing is intact their mental processes are normal in the sense of being carried on through the medium of the usual auditory spoken word symbols. The children take ordinary grammar school studies and have the same social relations as children with sight. Scholastic training goes up to the 10th grade. Vocational training includes, among other things, piano tuning, piano, pipe organ, chorus work and voice in music.

Psychometric examinations, Stanford scale.

Superior intelligence, intelligence quotient over 110	4
Normal intelligence, intelligence quotient 90–110	14
Subnormal, intelligence quotient 80–90	5
Borderline, intelligence quotient 70–80	8
Mental defect, intelligence quotient below 70	2

2 blind children (6 per cent) showed mental defect.

AN INTENSIVE STUDY OF DEPENDENTS IN THE SPECIAL HANDICAPS, OREGON STATE SCHOOL FOR THE DEAF.

By Ruth Montgomery, B. A., Graduate Assistant in Education, University of Oregon.

The State school for the deaf had a census of 113 pupils at the time of the survey—64 boys and 49 girls. Psychometric examinations were given to 93—58 boys and 35 girls.

It has now been definitely determined that the mental development of deaf children is not as rapid as that of children with normal hearing owing to the great handicap of having no auditory experience; hence, they can not think in terms of auditory word symbols or words as we hear them spoken. Rudolph Pintner, Psychological Monographs, Volume 24, in a study of deaf children found them to be about three years retarded when they were compared with hearing children. Our studies would seem to confirm this and three years retardation may be looked upon as the fairly constant handicap of all deaf children.

Psychometric examinations at the Oregon State School for the Deaf show these deaf children to be from two to three years retarded mentally, due to deafness. These same children who are two to three years retarded on account of deafness are perfectly normal in their social life and their school progress. Retardation of more than three years is found, however, in a group which is a little over 85 per cent of the total number examined. There were 10 boys and 3 girls who showed distinct mental defect. This diagnosis of actual quantitative intelligence lack, in addition to the usual amount of retardation due to deafness, was made upon the basis of the family history, school work, and social reactions, as well as on the psychometric examination.

The following table shows the results for the examinations made:

	Boys.	Girls.	Total.
Number of children	64	49	113
Number examined	58	35	93
Number showing mental defect	10	3	13
Per cent mental defect	17	8.8	14

A total of 13 deaf children (14 per cent) of the pupils in the school for the deaf show actual mental defect in addition to the normal retardation due to deafness.

(Note by the director: The results of studies made by the Oregon State survey and others indicate that complete or even partial deafness in children is a handicap much more likely to produce a definite and regular degree of retardation in mental development than blindness. Deafness (ear trouble) in school children is a very powerful factor in making the child overage for his school grade.)

THE COST AND CAUSES OF RETARDATION OF SCHOOL CHILDREN (IN THE CITY OF X, OREGON).

By L. C. Douglass, Instructor in Education, Extension Division University of Oregon, Special Field Investigator.

The following data are the results of an intensive study of 258 overage for grade children in the elementary schools of the city of X, Oreg., the majority of whom by some special deviation of conduct have attracted attention. In practically every case the child has spent almost all of his school life in Oregon, so whatever school influences have been for or against his retardation have arisen in this State.

Cost of retardation.—Each child was, on the average, overage for grade 1.89 years. This is equivalent to 488 children being retarded one year each. Before the war it cost the city of X $52.50 per pupil to run the elementary schools one year. Therefore the approximate extra cost of these children to the taxpayers of X was $25,620.

Mental defect and dullness as a cause.—Eighty unselected children from the group were given mental examinations. The results follow:

	Per cent.
Feeble-minded (heritable trait, offspring almost always feeble-minded)	14. 8
Dull or borderline cases (the latter probably feeble-minded)	38. 3
Normal mentality (poor mentality not a cause of retardation)	46. 9
	100. 0

Applying the above proportions to all over age for grade children we find that approximately 4.44 per cent of all children enrolled in the city will probably never have intelligence greater than that of a 12-year-old child.

Disease and physical defect.—These caused the retardation of 30 per cent of all the cases studied. In many other cases they were contributing causes. Ninety-six children suffered from physical defects. Two hundred and fourteen children had suffered from disease 547 times. Almost all the diseases mentioned could have been prevented by proper quarantine.

Emotional instability.—Thirty-one and eight-tenths per cent of the cases studied were emotionally unstable in some respect. These children are unable to adapt themselves to ordinary conditions of life, not having normally adequate interpretations of ideas. Their attitude is often antisocial. Of 37 children whose conduct is more or less delinquent (truants, liars, etc.), 70 per cent are emotionally unstable.

The basic causes of retardation are shown to be: Mental defect and dullness, 31 per cent; disease and physical defect, 30 per cent; poor heredity and improper home conditions, 20 per cent; economic and other causes, 19 per cent; total, 100 per cent. The emotional instability mentioned above is not counted as one of the basic causes but rather one of the most important contributing causes. Suggestions for the adequate handling of these cases will be found in the chapter on legislative recommendations.

SPECIAL STUDIES IN THE FIELD OF CHILD HYGIENE.

By Assistant Surgeon General TALIAFERRO CLARK, in charge of Field Investigations in Child Hygiene.

The researches of the United States Public Health Service have repeatedly demonstrated the practical necessity of recognizing both mental and physical factors in the causal constellation of all problems in child hygiene. This is particularly true in the case of the child who is overage for his school grade. A survey of the mental status of rural school children of Porter County, Ind., by Assistant Surgeon General Taliaferro Clark and Passed Assistant Surgeon W. A. Treadway demonstrated: "Of the 1,087 girls and 1,098 boys examined in the rural schools of Porter County, 93 of the former and 100 of the latter were retarded, and, excluding the exceptionally retarded children, constituted 8.7 per cent of the number examined. Including the exceptionally retarded children, the whole number of children requiring special attention was 214, or 9.3 per cent. Of the 1,087 girls and 1,098 boys examined in the rural schools of Porter County, 7, or 0.6 per cent of the former, and 14, or 1.2 per cent of the latter, were so exceptionally retarded that their mental development at no time will be greater than that of a child." They are actual mental defectives.

A survey of the mental status of rural school children in New Castle County, Del., by Surgeon E. H. Mullan showed: "Five-tenths of 1 per cent of 3,793 rural school children examined in New Castle County are definitely feeble-minded and in need of institutional treatment. An additional $1\frac{3}{10}$ per cent of the total number were so retarded mentally as to be considered probable mental defectives in need of institutional care."

These studies, inclusive of many diverse social, geographical, and industrial environmental factors, demonstrate the great importance of recognizing the very definite and constant rôle played by actual and potential mental defect as one of the fundamental causes of pupils becoming over age for their school grades.

Thorough examination of all retarded school pupils should be made with reference to both mental and physical condition, in the light of known environmental factors and parental influence. The modern diagnosis of inadequate school progress must include all possible fields of inquiry.

CHINESE AND JAPANESE IN OREGON.

Tables prepared by C. H. Gram, Commissioner, Bureau of Labor, State of Oregon.

The accompanying tables were prepared and all information concerning the Chinese and Japanese in Oregon was compiled by C. H. Gram, commissioner, bureau of labor, State of Oregon. The Oregon State survey is fortunate in receiving these figures, as they make a valuable ethnological study in connection with our study as to the fundamental causes of dependency and social failure. Total number of Chinese is 3,617; the total number of Japanese is 4,547. The number of the individuals in State institutions from these races is shown under the nativity tables in each institution's report.

Japanese in Oregon.

Counties.	Total number of Japanese.	Males.	Females.	Number of children.	Number married.	Number of children born in 1919.	Number engaged in commercial business.
Baker	197	156	33	8	32	3	22
Benton	34	30	3	1	2		
Clackamas [1]	163	58	39	66	37	10	
Clatsop	535	400	55	80	38	9	9
Columbia	101	92	7	2	7		
Coos	8	3	2	3	2	1	
Crook [2]	2	2					
Deschutes	53	35	7	11	7	1	
Douglas	6	2	1	3	1		
Gilliam	25	25					
Grant	37	32	3	2	3		
Harney	7	4	2	1	2	1	
Hood River [3]	383	196	81	106	81	29	5
Jackson	76	28	22	26	22	4	
Jefferson	41	38	2	1	2		
Josephine	7	3	2	2	1		
Klamath	22	14	2	6	2		9
Lake	4	4					
Lane	42	37	3	2	2		
Lincoln	7	6	1		1		
Linn	15	15					
Malheur	16	7	3	6	3	3	1
Marion	177	98	47	32	47	6	6
Morrow	5	5					
Multnomah [4]	2,021	1,004	466	551	445	117	222
Polk	218	158	47	13	45	2	
Sherman							
Tillamook							
Umatilla	58	34	10	14	10	3	2
Union	115	95	10	10	10	2	5
Wasco	72	42	15	15	14	3	5
Washington	90	41	18	31	18	6	
Yamhill	10	2	2	6	2		
Subtotals	4,547	2,666	833	998	836	200	286

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[1] In Clackamas County Japanese are leasing also 1,334 acres assessed at $98,280.

[2] In Crook County two Japanese bought 200 acres for which they paid $14,000. (Not yet on record. Information furnished by one of the purchasers.)

[3] In Hood River County Japanese are also paying taxes on 332 acres assessed at $46,260.

[4] In Multnomah County Japanese are also leasing 3,459 acres assessed at $493,370.

Japanese in Oregon—Continued.

Counties.	Number of males working for wages.			Number of females working for wages.			Average daily wage.		Average yearly income—Males.
	Commercial field.	Industrial field.	Agricultural field.	Commercial field.	Industrial field.	Agricultural field.	Males.	Females.	
Baker	32	101		5			$3.75	$2.00	$1,125
Benton		10	20				4.93		1,240
Clackamas	1	3	54			1	4.25	2.75	1,200
Clatsop	5	386		10			3.90	2.00	1,080
Columbia		92					5.00		1,250
Coos		3					5.00		1,250
Crook	2						4.50		900
Deschutes		35					3.60		1,000
Douglas		2					4.80		1,200
Gilliam		25					3.60		1,000
Grant		32					3.60		1,000
Harney		4					3.60		900
Hood River		48	143				4.00		1,200
Jackson	10	18		2			4.25	2.25	1,200
Jefferson		38					4.70		1,200
Josephine		3					4.00		1,100
Klamath			5				3.75		800
Lake		4					3.50		800
Lane		37					5.00		1,250
Lincoln		6					3.60		900
Linn		15					3.40		980
Malheur		6					3.40		900
Marion		60	32	3			4.75	2.50	1,200
Morrow		5					3.60		850
Multnomah	151	456	175	42			4.18	2.00	1,100
Polk		40	118				4.95		1,250
Umatilla		32	8				4.25		1,100
Union		90					3.60		1,000
Wasco	1	23	13	1			3.60	2.50	1,000
Washington		20	21				4.50		1,100
Yamhill		1	1				3.60		1,000
Subtotals	202	1,595	590	63		1			

Japanese in Oregon—Continued.

Counties.	Average yearly income—Females.	Average yearly house rental.[b]	Average per cent spent for domestic and foreign products.		Amount of property owned and assessed valuation.			
			Domestic.	Foreign.	City property.	Assessed valuation, ground and improvements.	Acreage.	Assessed valuation with improvements.
			Per cent.	*Per cent.*				
Baker	$600	$300	80	20				
Benton			85	15				
Clackamas	750		90	10			181½	$11,880
Clatsop	650		60	40	2	$344		
Columbia			85	15			30	450
Coos			90	10				
Deschutes			80	20				
Douglas			80	20				
Gilliam			80	20				
Grant			80	20				
Harney			85	15				
Hood River		360	85	15	51	15,865	1,273	70,345
Jackson	600	144	90	10	8	342	120	2,110
Jefferson			75	25				
Josephine			90	10				
Klamath		150	60	40			2,601	26,010
Lake			85	15	3	800	10	100
Lane			80	20	4	80		
Lincoln			80	20	39	195	200	1,500
Linn			85	15				
Malheur			85	15	1	230	36	2,920
Marion	650	240	75	25			51	1,210
Morrow			90	10				
Multnomah	600	450	92	8	([c])	([c])	116½	18,110
Polk		240	80	20				
Umatilla		350	85	15				
Union		120	85	15				
Wasco	750	240	85	15	1	8,000		
Washington			85	15	2	60	83	7,620
Yamhill			85	15				
Subtotal					111	25,316	4,702	142,255

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[b] Where no estimate of yearly rental is given, buildings occupied are either of nominal value or are used for business also.

[c] Figures not available.

Chinese in Oregon.

Tables prepared by C. H. Gram, Commissioner Bureau of Labor, State of Oregon.

Counties.	Total number of Chinese.	Males.	Females.	Number of children.	Number married.	Number of children born in 1919.	Number engaged in commercial business.
Baker	79	74	1	4	1		20
Benton	6	4	1	1	1	1	
Clackamas [1]	21	21					
Clatsop	277	200	17	60	17	7	22
Coos	37	16	4	17	4	1	3
Douglas	11	14					
Grant	20	20					
Harney	6	6					2
Hood River	11	11					
Jackson	29	25	2	2	2		2
Josephine	8	8					
Klamath	4	4					
Lake	2	2					
Lane	18	17	1		1		1
Lincoln	7	7					
Linn	15	15					1
Malheur	4	4					
Marion	64	35	9	20	7	3	7
Morrow	8	6	1	1	1	1	
Multnomah [2]	2,800	2,300	200	300	160	20	600
Polk	11	5	1	5	1		
Umatilla	78	74	2	2	2		12
Union	36	34	2		2		4
Wallowa	6	6					2
Wasco	51	40	4	7	4	1	4
Yamhill	5	5					
Subtotals	3,617	2,953	245	419	203	34	680

Counties.	Number of males working for wages.			Number of females working for wages.			Average daily wage.		Average yearly income—Males.
	Commercial field.	Industrial field.	Agricultural field.	Commercial field.	Industrial field.	Agricultural field.	Males.	Females.	
Baker		54					$3.64		$800
Benton		4					4.00		700
Clackamas	5	6	10				3.75		700
Clatsop		178					3.75		800
Coos		13					3.75		750
Douglas		14					3.75		850
Grant		20					4.00		700
Harney		4					4.00		750
Hood River		11					4.00		800
Jackson		23					3.00		600
Josephine		8					3.75		800
Klamath			4				3.50		700
Lake		2					4.50		1,000
Lane		16					4.00		900
Lincoln		7					4.00		700
Linn		14					4.00		750
Malheur		4					4.00		600
Marion	3	10	15	2			3.00	2.00	800
Morrow		6					3.75		700
Multnomah	300	1,250	150	65			2.75	1.50	700
Polk		3	2				4.50		800
Umatilla		62					3.75		800
Union		30					4.00		850
Wallowa		4					4.00		900
Wasco		36					4.40		800
Yamhill		5					4.50		900
Subtotals	308	1,784	181	67					

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[1] Clackamas County Chinese are also leasing 120 acres, assessed at $13,920.

[2] In Multnomah County Chinese are also leasing 168 acres, assessed at $31,970.

Chinese in Oregon—Continued.

Counties.	Average yearly income—Females.	Average yearly house rental.[3]	Average per cent spent for domestic and foreign products.		Amount of property owned and assessed valuation.			
			Domestic.	Foreign.	City property.	Assessed valuation ground and improvements.	Acreage.	Assessed valuation with improvements.
Baker			80	20	9	$5,300		
Benton			85	15	2	100		
Clackamas			75	25			320	$16,590
Clatsop		$375	85	15	25	9,657	5	1,000
Coos			80	20	26	28,125		
Douglas			75	25				
Grant			90	10	5	1,280		
Harney			90	10	4	1,000		
Hood River			85	15				
Jackson			80	20	6	1,970		
Josephine			60	40				
Klamath			90	10			1,224	12,240
Lake			100		1	400		
Lane			100					
Lincoln			95	5				
Linn			95	5				
Malheur			100					
Marion	$550	250	90	10	1	1,000	940	39,070
Morrow			80	20				
Multnomah	450	145	70	30	(4)	(4)	38	800
Polk			90	10				
Tillamook					47	1,550	10	450
Umatilla		120	85	15				
Union		160	80	20	7	790	3½	500
Wallowa			90	10	3	3,900		
Wasco		240	90	10	3	2,300		
Yamhill			90	10				
Subtotals					139	57,372	2,540½	70,650

[3] Where no estimate of yearly rental is given, buildings occupied are either of nominal value or are used for business also.

[4] Figures not available.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon.

[Figures represent number of individuals recorded in the communities.]

Types of handicap.	Male.	Female.	Total.
BAKER COUNTY.[1]			
[Population, 1920, 17,929.]			
Mental defect	4	2	6
Mental defect with delinquency	3		3
Mental defect with dependency, general	13	5	18
Mental defect with delinquency and dependency	4	1	5
Epilepsy with dependency		1	1
Tuberculosis with dependency	7	7	14
Blindness with dependency		1	1
Deafness with dependency		1	1
Crippling physical handicap with dependency	2	1	3
Delinquency	83	11	94
Delinquency with dependency	9	1	10
Delinquency with other neuro-mental disorders	1		1
Dependency from all other causes	44	75	119
Grand total individuals	170	106	276

[1] A ranch and mining county in eastern Oregon, which was distinctly frontier country not long ago. Counties of this type will show less delinquency on the records than a county of similar density of population, but of smaller area, in the older parts of the United States. Congestion of population and long organized police methods affect the incidence of officially recorded delinquency. The same applies to dependency in about the same degree. In Oregon, owing to diversity of climatic conditions, soil, industries area, and terrain it will be found that social conditions do not vary in direct proportion to density of population. Greenhorn in this county is the smallest incorporated town in the State; population 5 people.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon—Continued.

Types of handicap.	Male.	Female.	Total.
BENTON COUNTY.[2]			
[Population, 1920, 13,744.]			
Mental defect	3	1	4
Mental defect with delinquency	1	1	2
Mental defect with dependency, general	1	1	2
Mental defect with dependency and deafness	1		1
Insanity with dependency	3		3
Epilepsy with dependency	1		1
Other neuro-mental disorders with dependency	1		1
Blindness with dependency		1	1
Deafness with dependency	1	2	3
Crippling physical handicap with dependency	2		2
Delinquency	104	8	112
Dependency from all other causes	7	20	27
Grand total individuals	125	34	159
CLACKAMAS COUNTY.[3]			
[Population, 1920, 37,698.]			
Mental defect	4	3	7
Mental defect with dependency, general	4	2	6
Mental defect with dependency and other crippling handicaps	1		1
Mental defect with delinquency and dependency	1		1
Insanity with dependency	2		2
Epilepsy with dependency	3		3
Blindness with dependency	3		3
Deafness with dependency	3	2	5
Crippling physical handicap with dependency	3	3	6
Delinquency	94		94
Dependency from all other causes	25	76	101
Grand total individuals	143	86	229
CLATSOP COUNTY.[4]			
[Population, 1920, 23,030.]			
Mental defect	2	1	3
Mental defect with dependency, general	5	2	7
Insanity with dependency	8	4	12
Epilepsy with dependency	2		2
Blindness with dependency	1	1	2
Deafness with dependency			
Crippling physical handicap with dependency		1	1
Delinquency	99	3	102
Dependency from all other causes	46	28	74
Grand total individuals	163	40	203
COLUMBIA COUNTY.[5]			
[Population, 1920, 13,960.]			
Mental defect	6	2	
Mental defect with delinquency		3	3
Mental defect with dependency, general	1	1	2
Epilepsy with dependency	3		3
Tuberculosis with dependency	1		1
Deafness with dependency	1		1
Delinquency	34	13	47
Delinquency with dependency		1	1
Dependency from all other causes	57	73	130
Grand total individuals	103	93	196

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[2] A county of much greater density of population than the preceding county and which also contains other factors affecting the movement of population in addition to different climate, terrain, and general industries. Farming and fruit raising, general industries, a typical county of the Willamette Valley.

[3] This county is the border district for Multnomah, the latter being the metropolitan district of Oregon. Clackamas is growing rapidly and social conditions are at present subject to frequent changes. The returns given above for delinquents do not include all police arrests in towns. Police arrests are not complete in most of the following tables for the reason that accurate figures were not obtainable. The figures for delinquents shown in these tables refer chiefly to delinquents passing through the hands of the sheriff of the county. The smaller villages in any county had very few arrests. Police arrests are confined almost wholly to the larger towns. Industries: fruit growing and farming, typical of the Willamette Valley.

[4] Contains the city of Astoria, the oldest settlement in the Northwest, founded in 1801. Astoria is a deep sea port at the mouth of the Columbia River. Industries: Fishing and timber; also cranberries.

[5] Situated on the Columbia River just east of the preceding county. Industries: Fishing and lumbering.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon—Continued.

Types of handicap.	Male.	Female.	Total.
COOS COUNTY.[6]			
[Population, 1920, 22,257.]			
Mental defect	2	3	5
Mental defect with dependency, general	1	1	2
Mental defect with dependency and other crippling physical handicaps		1	1
Insanity with dependency	1	2	3
Epilepsy with dependency	1	2	3
Blindness with dependency		1	1
Deafness with dependency	2	6	8
Crippling physical handicap with dependency	2	2	4
Delinquency	38	6	44
Delinquency with dependency	4	4	8
Dependency from all other causes	40	156	196
Grand total individuals	91	184	275
CROOK COUNTY.[7]			
[Population, 1920, 3,424.]			
Mental defect		1	1
Mental defect with dependency, general	1		1
Insanity with dependency	1		1
Delinquency	23	1	24
Dependency from all other causes	5	6	11
Grand total individuals	30	8	38
CURRY COUNTY.[8]			
[Population, 1920, 3,025.]			
Mental defect	4	2	6
Insanity with dependency	1		1
Epilepsy with dependency		1	1
Delinquency	25	1	26
Dependency from all other causes	6	8	14
Grand total individuals	36	12	48
DESCHUTES COUNTY.[9]			
[Population, 1920, 9,622.]			
Mental defect	9	3	12
Mental defect with delinquency	1	1	2
Mental defect with dependency, general		1	1
Crippling physical handicap with dependency	1		1
Delinquency	96	8	104
Dependency from all other causes	20	31	51
Grand total individuals	127	44	171
DOUGLAS COUNTY.[10]			
[Population, 1920, 21,332.]			
Mental defect	5	2	7
Mental defect with delinquency	1	1	2
Mental defect with dependency and other crippling handicaps	1		1
Tuberculosis with dependency	1		1
Deafness with dependency	3	1	4
Crippling physical handicap with dependency	3	1	4
Delinquency	135	18	153
Dependency from all other causes	57	56	113
Grand total individuals	206	79	285

[6] Industries: Fishing, coal mining, dairying, and timber. This county, as most of the counties in Oregon, has to contend with social problems dependent upon lumbering, which involves frequent moves on the part of those engaged in it, thus causing loss of school advantages to their children; while the mere fact of the industry being in the forests makes it hard for the children to get to school. Other incidental factors are also found dependent both upon terrain and character of the industries.

[7] A county of the interior, just east of the Cascade Mountains. Industries: Dry-land farming.

[8] A county of the southwest coast region. Industries: Lumbering and fishing.

[9] A county just east of the Cascade mountains, in the center of Oregon. Industries: Lumber, stock, and dry-land farming.

[10] A county at the southern end of the Willamette Valley between the Cascade and Coast Ranges. Industries: Fruit and general farming, typical of the Willamette Valley.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon—Continued.

Types of handicap.	Male.	Female.	Total.
GILLIAM COUNTY.[11]			
[Population, 1920, 3,960.]			
Mental defect		3	3
Insanity with dependency	1		1
Blindness with dependency	1	1	2
Delinquency	33	3	36
Dependency from all other causes	3	4	7
Grand total individuals	38	11	49
GRANT COUNTY.[12]			
[Population, 1920, 5,496.]			
Mental defect	1	3	4
Mental defect with delinquency	2		2
Mental defect with dependency and other physical handicaps	1		1
Insanity with dependency	1		1
Epilepsy with dependency		1	1
Delinquency	26		26
Dependency from all other causes	6	6	12
Grand total individuals	37	10	47
HARNEY COUNTY.[13]			
[Population, 1920, 3,992.]			
Mental defect	1		1
Mental defect with dependency, general	5		5
Insanity with dependency	1		1
Tuberculosis with dependency	1		1
Crippling physical handicap with dependency	1		1
Delinquency	25	3	28
Dependency from all other causes	10	15	25
Grand total individuals	44	18	62
HOOD RIVER COUNTY.[14]			
[Population, 1920, 8,315.]			
Mental defect	8	1	9
Crippling physical handicap with dependency		1	1
Delinquency	55	7	62
Dependency from all other causes	3	18	21
Grand total individuals	66	27	93
JACKSON COUNTY.[15]			
[Population, 1920, 20,405.]			
Mental defect	10	8	18
Mental defect with delinquency	1		1
Mental defect with dependency, general	2	3	5
Insanity with dependency		3	3
Epilepsy with dependency		1	1
Tuberculosis with dependency	2	1	3
Crippling physical handicap with dependency	4	4	8
Delinquency	108	11	119
Dependency from all other causes	[16] 442	[16] 713	[16] 1,155
Grand total individuals	569	744	1,313

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[11] A county on the Columbia River in the middle section of the northern boundary line. Industries: Stock raising and dry farming. The conformation of terrain makes it difficult to utilize the river for irrigation.

[12] A county of eastern Oregon of quite different climatic conditions than the coast region or Willamette Valley. Industries: Lumbering, stock raising, and dry farming.

[13] A county of southeastern Oregon; area about that of the State of New Jersey. Industries: Stock raising and dry farming.

[14] A county on the Columbia River, just east of Multnomah the metropolitan center. Area small. Contains Mount Hood, altitude 11,225 feet. Industries: Fruit growing notably.

[15] A fairly large county on the southern boundary line. Industries: Fruit growing and lumbering.

[16] Includes the report of the individuals, dependent because of mental or physical disease or disorder, cared for by the Sacred Heart Hospital, Medford, during official year ending June 30, 1920. For additional cases not listed in table see report showing individuals in institutions by counties.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon—Continued.

Types of handicap.	Male.	Female.	Total.
JEFFERSON COUNTY.[17]			
[Population, 1920, 3,211.]			
Mental defect	1	....	1
Mental defect with delinquency	1	3	4
Mental defect with delinquency and dependency	1	....	1
Delinquency	10	....	10
Dependency from all other causes	....	18	18
Grand total individuals	13	21	34
JOSEPHINE COUNTY.[18]			
[Population, 1920, 7,655.]			
Mental defect	8	8	16
Deafness with dependency	1	....	1
Crippling physical handicap with dependency	2	....	2
Delinquency	50	1	51
Delinquency from all other causes	56	90	146
Grand total individuals	117	99	216
KLAMATH COUNTY.[19]			
[Population, 1920, 11,413.]			
Mental defect	9	5	14
Mental defect with delinquency	1	1	2
Mental defect with delinquency and dependency	....	1	1
Insanity with dependency	1	....	1
Deafness with dependency	1	....	1
Crippling physical handicap with dependency	1	....	1
Delinquency	87	11	98
Dependency from all other causes	[20] 11	[20] 49	[20] 60
Grand total individuals	111	67	178
LAKE COUNTY.[21]			
[Population, 1920, 3,991.]			
Mental defect	3	....	3
Crippling physical handicap with dependency	1	....	1
Delinquency	16	1	17
Dependency from all other causes	9	10	19
Grand total individuals	29	11	40
LANE COUNTY.[22]			
[Population, 1920, 36,166.]			
Mental defect	28	17	45
Mental defect with delinquency	2	1	3
Mental defect with dependency, general	10	7	17
Mental defect with dependency and epilepsy	1	....	1
Mental defect with dependency and other crippling handicaps	1	2	3
Mental defect with delinquency and dependency	1	....	1
Insanity with dependency	5	6	11
Epilepsy with dependency	2	5	7

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[17] A county of central Oregon, just east of the Cascade Mountains. Industries: Stock raising and dry farming.

[18] A county on the southern boundary line, traversed by the Coast Range Mountains. Industries: Mining.

[19] A large county on the southern boundary line east of the Cascade Mountains. It contains Crater Lake National Park and Crater Lake, which is considered to be the most beautiful small lake in the world, both on account of its picturesque situation in the heart of an extinct volcano and on account of the wonderful coloring of the water, which is a sparkling, deep sapphire blue. Industries: Stock raising and dry farming.

[20] Reports from general hospitals not available, and therefore the dependents in general hospitals are not included.

[21] A county as large as some Eastern States. It occupies a central position in the southern tier of counties. and offers an unlimited field for development. Industries: Stock raising and dry farming.

[22] Lane County is typical of the Willamette Valley counties. The fertile valley soil is unexcelled for fruit growing and general farming. The eastern edge is bordered by the Cascade Mountains. Forests cover all the land, both highlands and lowlands, not under cultivation. The thriving town of Eugene, population 10,593 (1920), is the county seat. From the buttes around the town may be seen the snow-capped peaks of the Cascades to the east, while in the west rises the Coast Range, separating the coast from the valley of the Willamette River.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon—Continued.

Types of handicap.	Male.	Female.	Total.
LANE COUNTY—Continued.			
Other neuro-mental disorders with dependency		1	1
Tuberculosis with dependency	2		2
Blindness with dependency	1		1
Deafness with dependency	1	4	5
Crippling physical handicap with dependency	13	12	25
Delinquency	337	20	357
Delinquency with dependency		1	1
Dependency from all other causes	81	[23] 87	[23] 158
Grand total individuals	485	163	648
LINCOLN COUNTY.[24] [Population, 1920, 6,084.]			
Mental defect	9	6	15
Mental defect with delinquency	3	3	6
Mental defect with dependency and epilepsy		1	1
Mental defect with delinquency and dependency	1		1
Blindness with dependency	2		2
Deafness with dependency	1	1	2
Crippling physical handicap with dependency	4		4
Delinquency	12	2	14
Dependency from all other causes	12	42	54
Grand total individuals	44	55	99
LINN COUNTY.[25] [Population, 1920, 24, 550.]			
Mental defect	13	4	17
Mental defect with delinquency	1	3	4
Mental defect with dependency, general	5	3	8
Mental defect with dependency and epilepsy	3		3
Insanity with dependency		2	2
Epilepsy with dependency	1	1	2
Blindness with dependency	1	1	2
Deafness with dependency	5	2	7
Crippling physical handicap with dependency		1	1
Delinquency	351	15	366
Delinquency with insanity	1		1
Delinquency with epilepsy	1		1
Dependency from all other causes	[26] 51	[26] 60	[26] 111
Grand total individuals	433	92	525

[23] Includes partial or complete dependents cared for in Mercy Hospital (48), Eugene; Willamette Hospital (1), Eugene; Springfield Hospital (47), Springfield. Not including defective children in the schools, nor defective, insane, and delinquent children and adults in State institutions, there is found a total of 648 defective, delinquent, or dependent individuals in the community of Lane County. There are 648 social liabilities living in the county at the time of the Oregon State survey, representing 1.8 per cent of the total population of the county. This means there are to be found 18 persons in every 1,000 residing at all times in this county who have plainly demonstrated, by their subnormal, defective, delinquent, dependent, or inefficient conduct, both potential and actual inability to meet the demands of normal, efficient, and constructive citizenship. The detection, treatment, and eradication of mental and physical handicap to happy, successful and efficient citizenship is of the highest practical importance. Upon clear thinking, sound judgment, and conduct useful to society rest the future greatness of the State.

[24] A county of the north-central coast region. Industries: Lumbering and fishing. Coast resorts for tourists are to be found here, where sea and forest, beach and mountains, fish and game afford opportunity for delightful vacation days.

[25] A Willamette Valley county, just north of Lane County, in the center of the cherry and prune district. Industries: Willamette Valley farms; fruit and lumbering.

Lane and Linn Counties may be taken as examples of community districts where environmental industrial and geographical factors affecting citizen health and conduct are "normal." The incidence of mental and physical defect, disease, or disorder and of delinquency and dependency here found represents essentially the irreducible ratio of subnormal or inefficient conduct which we have grown accustomed to look upon as a sad but unchangeable part of our everyday life. Public health and public welfare are obtainable by the simple expedient of learning the basic causes of sickness and inefficient conduct and then, facing the facts, eradicate these causes. Let us learn to look for basic causes, systematize our united efforts for public welfare, and by such coordination of methods rehabilitate the handicapped and at the same time permanently protect the State.—Note by the director of the Oregon State survey.

[26] Does not include detailed figures for individuals who are dependent on public or private charitable funds, who are sick in general hospitals, as accurate data was not available.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon—Continued.

Types of handicap.	Male.	Female.	Total.
MALHEUR COUNTY.[27]			
[Population, 1920, 10,907.]			
Mental defect	1	2	3
Insanity with dependency	7	7	14
Delinquency	82	9	91
Dependency from all other causes	[28] 15	[28] 21	[28] 36
Grand total individuals	105	39	144
MARION COUNTY.[29]			
[Population, 1920, 47117. Practically all State institutions are in this county. Table does not include any inmates of these State institutions.]			
Mental defect	29	14	43
Mental defect with delinquency	6	1	7
Mental defect with dependency, general	4	5	9
Mental defect with dependency and epilepsy	2		2
Mental defect with dependency and other crippling handicaps	1		1
Mental defect with delinquency and dependency	1	1	2
Insanity with dependency	4	1	5
Epilepsy with dependency	2	1	3
Neuromental disorder with dependency	1		1
Blindness with dependency	7	3	10
Deafness with dependency	21	14	35
Delinquency	449	27	476
Dependency from all other causes	[30] 108	[30] 116	[30] 224
Grand total individuals	635	183	818
MORROW COUNTY.[31]			
[Population, 1920, 5,617.]			
Mental defect	2	1	3
Insanity with dependency	1		1
Epilepsy with dependency		1	1
Crippling physical handicap with dependency		1	1
Mental defect with dependency and deafness		1	1
Delinquency	56	2	58
Dependency from all other causes	10	14	24
Grand total individuals	69	20	89
MULTNOMAH COUNTY.[32]			
[Population, 1920, 275,898.]			
Mental defect	113	103	216
Mental defect with delinquency	14	8	22
Mental defect with dependency, general	110	21	131
Mental defect with dependency and blindness	1		1
Mental defect with dependency and epilepsy		1	1
Mental defect with dependency and other crippling handicaps	5	2	7
Mental defect with delinquency and dependency	3		3
Insanity with dependency	32	23	55
Epilepsy with dependency	11	3	14
Neuromental disorders with dependency	4		4
Tuberculosis with dependency	2	1	3
Blindness with dependency	13	4	17

[27] A county of enormous size in the southwest corner of Oregon. Area about the same as the State of New Jersey. Industries: Stock raising and dry farming.

[28] Detailed information as to sex in all cases not available in working up totals. Twelve of these insane cases have now been committed to the Eastern Oregon State Hospital.

[29] A typical county of the Willamette Valley; fertile soil and rolling fields. Industries: Farming, fruit raising, notably cherries. Salem, the capital of Oregon, has a population of 17,679 (1920). The city contains many beautiful buildings housing the handicapped, delinquent, or dependent wards of the State. The ratio of Marion County residents who are inmates of State institutions will be found higher than that of a number of other counties. This is a demonstration of the fact that accessibility for help, in the form of adequate institutions, homes, hospitals, clinics, dispensaries, or other agencies, always means more handicapped persons helped. The more complete the final rehabilitation the less the eventual cost to society. The success of such measures depends upon the accuracy of diagnosis as to fundamental causes of social inadequacy in the first place.

[30] No information in detail as to dependents in general hospitals available.

[31] A county on the Columbia River in the northeast section of Oregon. Industries: Dry farming and stock raising. The conformation of the Columbia River channel makes irrigation difficult.

[32] For additional mental and physical dependents and delinquents, residents of Multnomah County in institutions, see chart for same where all counties are represented.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon—Continued.

Types of handicap.	Male.	Female.	Total.
MULTNOMAH COUNTY—Continued.			
Deafness with dependency	33	31	64
Crippling physical handicap with dependency	35	13	48
Delinquency	[33] 21,558	[33] 1,680	[33] 23,238
Dependency from all other causes	[34] 13,686	[34] 9,221	[34] 22,907
Grand total individuals	35,620	11,112	46,732
POLK COUNTY.[35]			
[Population, 1920, 14,181.]			
Mental defect	7	6	13
Mental defect with delinquency	2	2	4
Mental defect with dependency, general	5	2	7
Mental defect with dependency and epilepsy	2		2
Mental defect with dependency and other crippling handicaps	1		1
Mental defect with delinquency and dependency	1		1
Insanity with dependency	2	2	4
Deafness with dependency	6	5	11
Crippling physical handicap with dependency		1	1
Deliquency	134	8	142
Delinquency with dependency		4	4
Dependency from all other causes	[36] 32	[36] 34	[36] 66
Grand total individuals	192	64	256
SHERMAN COUNTY.[37]			
[Population, 1920, 3,826.]			
Mental defect	2	2	4
Mental defect with dependency, general	1	1	2
Blindness with dependency	1		1
Crippling physical handicap with dependency	1		1
Delinquency	11		11
Dependency from all other causes	4	4	8
Grand total individuals [38]	20	7	27

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[33] Contains figures from official report issued by the sheriff's office, the police department, and the women's protective division of the police department, as well as other agencies handling delinquents—3,744 arrests which were for violation of traffic ordinances and reckless driving are included.

[34] Contains figures concerning individuals, partial or complete dependents, receiving aid from public or private funds as medical or surgical patients in the Portland Free Dispensary (public and private funds), the Morning Side Hospital (no information), the Mountain View Sanitarium (dependents on private funds only), Waverleigh Sanitarium (dependents on private funds only), Good Samaritan Hospital (public and private funds), Emanuel Hospital (public and private funds), Multnomah County Hospital (public funds only), Portland Sanitarium (dependents on private funds only), St. Vincent's Hospital (public and private funds), Sellwood General Hospital (no dependents on public or private funds cared for), or were cared for as dependents in the community or were assisted by the agents of the public welfare bureau (public funds), or were known to have received assistance otherwise as whole or partial dependents in the community, including a monthly average of 141 widows entitled to relief under the widows' pension act, but not including the number of such widows' children in the metropolitan district. Multnomah County contains the city of Portland, population 258,288 (1920). This is a deep-sea port sending vessels to all parts of the world and affords an outlet for all the industries of Oregon. Multnomah is a small county in area, but contains more people than any other county in the State; the density of population therefore is very much greater than in any other section of Oregon. Portland, situated on the Willamette River near its confluence with the mighty Columbia, is ideally located for all purposes of health, commerce, and living conditions. It has shown great community interest in all matters of public welfare and is the home of the "safety-first" movement in industry. The ratio of either delinquents or dependents is approximately 80 per 1,000 of the county population.

[35] A county of fairly small area in the north central section of the Willamette Valley. Industries: General farming, fruit growing, and the raising of fine stock.

[36] Details of dependents sick in general hospitals not available.

[37] This county, in the north central section of the Columbia River district, is a good exmaple of local conditions relating to delinquency and dependency in the less densely populated areas. Industries: Stock raising and dry farming.

[38] Ten arrests were made by the sheriff; four individuals passed through the county jail during the past year. The total cost of running the sheriff's office for the same period was $3,812. This is not an excessive figure as to costs. It illustrates however the high cost to the taxpayer of the inefficient, delinquent, antisocial individual. Early diagnosis and suitable care, treatment, and training would eliminate much of this economic wastage in future generations. The cost to the county for an average of two widows' pensions each month was $1,750 for the year. The amount of county funds spent on dependency was $1,600 for the year ending June 30, 1920. Dependency is conduct inefficient and valueless to constructive citizenship. The cost of dependency anywhere is very high per capita both as to the cost for the maintenance of the dependent and the further per capita loss entailed by his unproductive conduct.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon—Continued.

Types of handicap.	Male.	Female.	Total.
TILLAMOOK COUNTY.[39]			
[Population, 1920, 8,776.]			
Mental defect	6	1	7
Mental defect with delinquency	1	1	2
Mental defect with dependency and other crippling handicaps		1	1
Mental defect with delinquency and dependency	1	4	5
Blindness with dependency	1	1	2
Deafness with dependency	1	1	2
Delinquency	191	4	195
Dependency from all other causes	20	23	43
Grand total individuals [40]	221	36	257
UMATILLA COUNTY.[41]			
[Population, 1920, 25,946.]			
Mental defect	8	4	12
Mental defect with dependency, general	10	1	11
Tuberculosis with dependency	1		1
Blindness with dependency	3		3
Deafness with dependency		1	1
Crippling physical handicap with dependency	1		1
Delinquency	[42] 224	[42] 14	[42] 238
Dependency from all other causes	5	26	31
Grand total individuals	252	46	298
UNION COUNTY.[43]			
[Population, 1920, 16,636.]			
Mental defect	4	2	6
Mental defect with dependency, general		2	2
Mental defect with dependency and epilepsy	1	2	3
Mental defect with delinquency and dependency	1		1
Insanity with dependency	1	1	2
Epilepsy with dependency	1		1
Tuberculosis with dependency	2	2	4
Blindness with dependency		1	1
Deafness with dependency	1	1	2
Crippling physical handicap with dependency	1		1
Delinquency	148	6	154
Dependency from all other causes	16	30	46
Grand total individuals	176	47	223

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[39] A county of the northwest coast region. Industries: Fishing, dairying, and lumbering.

[40] Twelve widows' pensions cost $3,030.25; amount spent on dependency last official year, $6,375.48; average number of dependent individuals receiving county aid each month, 9; total dependents receiving county aid for past official year, 31. Note the per capita cost of dependency for maintenance alone.

[41] A typical county of eastern Oregon. Industries: Great ranches for wheat growing, cattle and sheep raising. The county which stages the annual "round-up" at Pendleton. This county is part of that enormous agricultural and stock raising district known as the inland empire of the Northwest. In its size, productivity, and citizen activity this county typifies the great West of song and story. In such a district far from slums, overcrowding, and unhygienic surroundings it may be stated in passing that any individual who develops defective, delinquent, or dependent conduct while living under such favorable conditions of climate, soil, and industrial competence demonstrates at once his own constitutional inferiority of personal make up. Inefficient, delinquent, or dependent conduct in the presence of a favorable environment is the hall-mark of mental or physical defect, disease, or disorder.

[42] Exact details from city police not available. There appears to be a low rate of dependency in this county. There is a monthly average of 20 widows receiving widows' pensions.

[43] A county of northeastern Oregon, just east of Umatilla. Industries: Grain, stock raising, fruit, and timber, also considerable dry farming. This county lies in the curve to the west taken by the old Oregon Trail as is passed through the northeast corner of the State, then bent westward toward the present location of Portland. The contour of Union County varies greatly in different sections due to the Blue Mountain range on its western border dividing it from Umatilla County, and the Wallowa Mountains along its eastern edge separating it from Wallowa County. These mountains determined the curves in the old Oregon Trail as it stretched away to the west.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon—Continued.

Types of handicap.	Male.	Female.	Total.
WALLOWA COUNTY.[44]			
[Population, 1920, 9,778.]			
Mental defect	5	1	6
Mental defect with dependency, general	1	....	1
Mental defect with delinquency and dependency	1	....	1
Insanity with dependency	....	1	1
Tuberculosis with dependency	6	4	10
Delinquency	96	6	102
Delinquency with insanity	1	....	1
Dependency from all other causes	9	54	63
Grand total individuals	119	66	185
WASCO COUNTY.[45]			
[Population, 1920, 13,648.]			
Mental defect	10	4	14
Mental defect with dependency, general	3	2	5
Tuberculosis with dependency	1	2	3
Crippling physical handicap with dependency	2	5	7
Delinquency	[46] 80	[46] 9	[46] 89
Dependency from all other causes	[47] 206	[47] 121	[47] 327
Grand total individuals	302	143	445
WASHINGTON COUNTY.[48]			
[Population, 1920, 26,376.]			
Mental defect	[49] 15	[49] 16	[49] 31
Mental defect with delinquency	[49] 2	[49] 2	[49] 4
Mental defect with dependency, general	9	1	10
Mental defect with dependency and deafness	1	....	1
Mental defect with dependency and epilepsy	....	1	1
Mental defect with dependency and other crippling handicaps	1	....	1
Mental defect with delinquency and dependency	[49] 9	[49] 8	[49] 17
Insanity with dependency	2	....	2
Epilepsy with dependency	3	1	4
Neuro-mental disorder with dependency	....	1	1
Blindness with dependency	1	1	2

[44] The county is in the northeast corner of the State. It is just east of Union and Umatilla Counties but of quite different general characteristics. The terrain is quite mountainous due to the Wallowa Mountains, which are a spur off the Blue Mountain range. The county contains a national-forest reserve and Wallowa Lake, an inland body of water of great natural beauty. The surface soil shows it to be part of an ancient glacial moraine. Industries: Lumbering, farming, and mining.

[45] A county on the Columbia River just east of Hood River and Clackamas and not far from Multnomah, the metropolitan center of the State. This fact, together with social conditions found in mountain settlements, may account for some of the special features to be seen here relating to dependency. Industries: Fishing, fruit raising, and general farming.

[46] Including delinquents handled by sheriff and delinquents handled otherwise and by local police. Exact details in all cases not available.

[47] A greater number of individuals in this county in proportion to population received aid as dependents on public funds than is usually found to be the case in a rural county in Oregon. Two hundred males received aid outside of the county poor farm, according to the report of the supervisor of the county farm. There was a monthly average of 26 widows' pensions. The average number of dependent individuals receiving county aid was 100 and the total number of such dependents was 1,488, according to the report of the county court. The cost of this dependency was $12,844.60. This does not include indirect costs of any kind. Widows' pensions cost $4,671 during the same period.

[48] A county just west of the metropolitan district, adjoining the coast section and bounded by the coast range mountains in the west. Industries: Willamette Valley fruit growing and general farming.

[49] Most of the individuals in these groups in this (and all counties) come from a few families. The determination and elimination of such centers for social degeneracy is of great practical importance. In this county one mentally defective woman has had five and another six children; their "homes" are poor and squalid; the children are unable to learn much; their delinquent conduct is combined with dependency; their social inadequacy is first seen as truancy and telling lies, then it develops into stealing, assaults, rape, family desertion, illicit consorts, and gross permiscuous sex offense. Some have been dependents in the hospital for the insane, some in the school for feeble-minded, others in jails. Subnormal, defective, inefficient personalities make higher tax costs for the efficient constructive citizen. The antisocial, inefficient, defective individual should, once he is ascertained, be adequately cared for by a system of permanent supervision or adequate community care. The eradication of such sources of social and economic weakness will make for adequacy, strength, and happiness for all citizens and the further progress of the State. The cost to the county of the comparatively small number of depentents here shown was $7,759.37 for the year ending June 30, 1920. During the same period $3,606.75 was spent on widows' pensions. There was an average number of 24 widows receiving pensions each month. Total number of dependents receiving county aid only for the year was 85—report by county clerk. These costs, excluding the widows, do not include the economic loss to society due to the stoppage of constructive effort on the part of the dependent himself nor the cost of incidentals otherwise—courts, police work, salaries of public officials, etc.

Inadequate conduct; medico-psychological-sociological findings in the communities—36 counties, State of Oregon—Continued.

Types of handicap.	Male.	Female.	Total.
WASHINGTON COUNTY—Continued.			
Deafness with dependency	3	....	3
Crippling physical handicap with dependency	....	1	1
Delinquency	[50] 252	[50] 12	[50] 264
Dependency from all other causes	55	57	112
Grand total individuals	353	101	454
WHEELER COUNTY.[51]			
[Population, 1920, 2,791.]			
Mental defect	3	3	6
Epilepsy with dependency	1	1	2
Blindness with dependency	....	2	2
Delinquency	42	3	45
Dependency from all other causes	17	16	33
Grand total individuals	63	25	88
YAMHILL COUNTY.[52]			
[Population, 1920, 20,529.]			
Mental defect	19	17	36
Mental defect with delinquency	....	1	1
Mental defect with dependency, general	3	3	6
Mental defect with dependency and blindness	1	....	1
Mental defect with dependency and epilepsy	1	....	1
Mental defect with dependency and other crippling handicaps	1	....	1
Mental defect with delinquency and dependency	1	....	1
Insanity with dependency	4	3	7
Blindness with dependency	1	....	1
Delinquency	[53] 185	[53] 10	[53] 195
Dependency from all other causes	[54] 45	[54] 54	[54] 99
Grand total individuals	261	88	349
ALL COUNTIES, GRAND TOTALS.[55]			
[Population, 1920, 783,285.]			
Mental defect	354	251	605
Mental defect with delinquency	42	32	74
Mental defect with dependency, general	194	64	258
Mental defect with dependency and deafness	2	1	3
Mental defect with dependency and blindness	2	....	2
Mental defect with dependency and epilepsy	10	5	15
Mental defect with dependency and other crippling handicaps	13	6	19
Mental defect with delinquency and dependency	26	15	41
Insanity with dependency	78	55	133
Epilepsy with dependency	31	19	50
Other neuromental disorders with dependency	6	2	8
Tuberculosis with dependency	26	17	43
Blindness with dependency	36	18	54
Deafness with dependency	84	72	156
Crippling physical handicap with dependency	79	47	126
Delinquency	25,349	1,933	27,282
Delinquency with dependency	13	12	25
Delinquency with insanity	2	....	2
Delinquency with epilepsy	1	....	1
Delinquency with other neuromental disorders	1	....	1
Dependency from all other causes	15,219	11,432	26,651
Grand total individuals	41,568	13,981	55,549

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[50] Exact details as to all police arrests in towns not available.

[51] A thinly settled rural county in the center of Oregon, quite mountainous in its northern and southern sections. Has the smallest total population of any county in the State. Industries: Dry farming and stock raising.

[52] A county in the northern section of the Willamette Valley with the Coast Range Mountains on its western boundary. The Grand Ronde Indian Reservation is in the southwestern corner of the county. Industries: Willamette Valley fruit growing and general farming.

[53] Includes activities of sheriff's office as well as the number of police arrests. Exact details of such arrests not all available.

[54] An average of 36 widows' pension cases each month. "We average over $1,000 per month for these."—From an official report.

[55] Records and reports collected by all city, village, and county officials; officers of welfare groups; pyysicians, clergymen, lawyers, nurses, and interested citizens generally. This table does not contain any person now resident in any institution, either city, county, or State, except dependents sick in general hospitals. For individuals in institutions, by counties, see chart where all counties are represented.

The exact number of individuals dependent on city or county funds who are sick in general hospitals is not complete for the reason that some of the smaller institutions, which failed to furnish information, make no annual printed report. It should be made mandatory for all private institutions caring for dependents of any type, who are supported by either State, county, city, or village funds, or by private philanthropy, to issue a printed report at stated intervals showing the number of such dependent individuals and the cost to the public of such whole or partial dependents, including dependents due to mental defect, disease, or disorder, as well as dependents due to physical defect, disease, or disorder, such reports of such institutions to be returnable to the central State board of control for inspection, compilation, and preservation as a public record.

Total number of individuals showing mental and physical defect, disease, or disorder, and individuals who are or recently have been delinquents and individuals who are dependents from all other causes in the communities, 55,549.

The ratio of such social liabilities now in the communities to the whole population is 70 per 1,000.

The percentage of such social liabilities in the communities to the whole population is 7 per cent.

TEACHERS' REFERENDUM AS TO WHY PUPILS BECOME OVER-AGE FOR THEIR SCHOOL GRADE, REPRESENTING A STUDY OF ALL THE OVER-AGE FOR GRADE SCHOOL CHILDREN AMONG 32,480 PUPILS, OR 22 PER CENT OF THE TOTAL SCHOOL ENROLLMENT IN THE 36 COUNTIES OF THE STATE OF OREGON.

THE SCHOOL CHILDREN.

In school life and school progress may first be seen the symptoms of inadequate, inefficient, unsuccessful conduct. If not recognized and adequately corrected during adolescence, such traits inevitably tend to develop into more or less fixed habits of thought and behavior which render that child incapable of attaining the fullest possible measure of success both as a healthy, active individual and as a constructive citizen. The number of such children should be recorded that the State may know their needs.

The retarded pupil is overage for his grade because of some specific cause which acts as a handicap to expected progress. It is the duty of the State, county, city, village, and rural school authorities, including all teachers, to ascertain this cause. Such causes are fundamental factors for pupil retardation.

Eradicate all causes which act as a handicap to pupil efficiency in attaining grades according to expected progress.

This is constructive help of the highest practical value. It insures health, happiness, and success for your children.

All overage for grade retarded pupils recorded by the teachers' referendum made for the Oregon State survey were rated according to the following scale, which indicates the age rate for the normal, usual, and expected progress in school grades:

A pupil to be at normal expected age-grade should be in grade 1 when 6 to 7 years old; grade 2 when 7 to 8 years old; grade 3 when 8 to 9 years old; grade 4 when 9 to 10 years old; grade 5 when 10 to 11 years old; grade 6 when 11 to 12 years old; grade 7 when 12 to 13 years old; grade 8 when 13 to 14 years old.

A pupil is retarded in age grade and overage for grade when he is one or more years older than he should be for the grade he is in. (See table above.) For instance, if he is 10 years old and is now in the second grade, he is two years retarded. If he is 16 years old and is in the seventh grade, he is three years retarded. If he is 14 years old and is still in the first grade, he is seven years retarded.

[Figures represent number of children overage for grade on whom reports were received.]

Causes.	Boys.	Girls.	Total.
BAKER COUNTY.[1]			
Parental:			
Loss of one or both parents (including divorce)	2		2
Indifference to child's welfare		1	1
Lack of home training	1		1
Child not kept in school	2	4	6
Irregular attendance	4	5	9
Economic:			
Poor home and living conditions	2		2
No opportunity, child	2	3	5
Child kept home to work	4		4
Environmental:			
Entered school late (various reasons)	1		1
Foreign born; parents, child; home language	1	1	2
Lived long distance from school		1	1
Irregular sessions	1	1	2
Miscellaneous: No cause assigned	17	7	24
Physical:			
Undernourished	8	7	15
Tuberculosis	1		1
Defective vision (eye disorders)	4	1	5
Defective hearing (ear disorders)	2		2
Defective speech	2	1	3
Adenoids, tonsils, throat trouble	6	2	8
Crippled (various types)		2	2
Ill health, general	6	7	13
Mental:			
Mental dulling and mental defect	40	26	66
Affective deviation	1		1
Psychopathic states	1		1
All other neuro-mental disorders	1		1
Total	109	69	178
1 boy mentally defective, 1 girl blind, 1 girl deaf and dumb, 2 boys crippled, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 37.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	21	17	38
Child has relative in community with neuromental disorder	6	6	12
Child entitled to relief by crippled children's law	6	4	10

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[1] Note by director of the Oregon State survey: Any pupil in school in all the 36 counties of the State whom the teacher reported to the survey as suffering from some form of mental or physical defect, disease, or disorder which appeared to be capable of cure or amelioration by medical or surgical care or treatment, and when such child was caused to become retarded or over age for his or her school grades by reason of such defect, disease, or disorder, and further, when the parents, guardians, or other near relatives or friends had made no attempt to remove such handicap from such over age for grade retarded school pupil, such child was recorded as entitled to relief under the crippled children's law.

Causes.	Boys.	Girls.	Total.
BENTON COUNTY.[2]			
Parental:			
Loss of one or both parents (including divorce)	4	1	5
Indifference to child's welfare	2		2
Child not kept in school	2	3	5
Irregular attendance	2	2	4
Economic:			
Poor home and living conditions		1	1
No opportunity, child	3		3
Child kept home to work		1	1
Moved frequently	7	12	19
Environmental:			
Entered school late (various reasons)	2	1	3
No school available		1	1
Irregular sessions	1		1
Inadequate instruction		1	1
Miscellaneous: No cause assigned	2	4	6
Physical:			
Undernourished		1	1
Defective vision (eye disorders)	6	1	7
Defective hearing (ear disorders)	1	2	3
Defective speech	1		1
Adenoids, tonsils, throat trouble	3	2	5
Crippled (various types)	1		1
Ill health, general	4	3	7
Bad sex habits		1	1
Mental:			
Mental dulling and mental defect	21	13	34
Affective deviation	1		1
Psychopathic states	1		1
Total	64	50	114
1 boy and 1 girl deaf, 1 boy feeble-minded, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 29.8.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	29	25	54
Child has relative in community with neuromental disorder	5	2	7
Child entitled to relief by crippled children's law	3	1	4
CLACKAMAS COUNTY.[3]			
Parental:			
Heredity and constitutional inferiority	5		5
Loss of one or both parents (including divorce)	19	1	20
Indifference to child's welfare	2	2	4
Lack of home training	2	2	4
Child not kept in school	8	1	9
Irregular attendance	7	6	13
Economic:			
Poor home and living conditions	2	6	8
Parental poverty	1	1	2
Child kept home to work	1	5	6
Moved frequently	14	14	28
Environmental:			
Entered school late (various reasons)	11	16	27
Sickness in family	1		1
Foreign born; parents, child; home language	1	4	5
Lived long distance from school	1	2	3
Poor, dangerous, or mountain roads	2		2
No school available	4	1	5
Lack of school advantages	3		3
Inadequate instruction	2		2
Miscellaneous:			
Cause undifferentiated	3		3
No cause assigned	33	20	53

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[2] Note by director of the Oregon State survey: In all these 36 charts, relating to children over age for their school grades, attention is drawn to the number of individual children who had one or more brothers sisters, or other relatives in school who were also over age for their school grades. Educators, physicians, and school officials should be on the lookout for family or related groups of school children, all or many of whom are one or more years over age for their school grades. Such groups are plainly demonstrating their difficulties. The community should ascertain and correct the handicap, be it environmental, physical, or mental.

[3] Note by director of the Oregon State survey: In all these 36 charts relating to children over age for their school grades, attention is drawn to the number of individual children who had one or more relatives in the community showing a neuromental disorder. For the most part such relatives were cases of insanity, epilepsy, chorea, "nervous" disorders of various kinds, as well as certain cases indicating essentially mental defect or affective deviation (emotional instability with inadequate delinquent conduct). Educators, physicians, and school officials should be on the lookout for children, failing in school grades, who have relatives with neuromental disorders. The handicap of the child may be removed or overcome through judicious care, treatment, and training; unfortunate end-results may thus be avoided, happiness given to the individual, and a constructive citizen to the State.

Causes.	Boys.	Girls.	Total.
CLACKAMAS COUNTY—Continued.			
Temperamental:			
Bad habits, bad conduct, lazy	7	1	8
Careless, indifferent, inattentive	3	1	4
Poor application, dreamer, other interests	4		4
Bashful, timid, self-conscious	4	3	7
Truancy	1		1
Physical:			
Undernourished	2	3	5
Tuberculosis		1	1
Defective vision (eye disorders)	9	5	14
Defective hearing (ear disorders)	2	2	4
Defective speech	1		1
Adenoids, tonsils, throat trouble	3	3	6
Crippled (various types)	4	2	6
Ill health, general	19	16	35
Mental:			
Mental dulling and mental defect	50	31	81
Affective deviation	2	1	3
Psychopathic states	3		3
Epilepsy	3	1	4
All other neuromental disorders	1		1
Total	240	151	391
3 boys and 1 girl deaf, 2 boys blind, 2 boys and 1 girl feeble-minded, 2 boys crippled, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 20.7.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	56	29	85
Child has relative in community with neuromental disorder	6	14	20
Child entitled to relief by crippled children's law	9	8	17
CLATSOP COUNTY.			
Parental:			
Indifference to child's welfare	1	1	2
Child not kept in school	1		1
Irregular attendance	1	1	2
Economic:			
Poor home and living conditions		1	1
Moved frequently	2	1	3
Environmental:			
Entered school late (various reasons)	3	3	6
Foreign born; parents, child; home language	2	4	6
Inadequate instruction		1	1
Lax enforcement of truancy laws	1	2	3
Miscellaneous:			
Cause undifferentiated	2	1	3
No cause assigned	14	3	17
Temperamental:			
Bad habits, bad conduct, lazy	2		2
Careless, indifferent, inattentive	2	1	3
Poor application, dreamer, other interests	1		1
Bashful, timid, self-conscious	1		1
Physical:			
Undeveloped	1	2	3
Too rapid growth	2		2
Defective vision (eye disorders)	3	1	4
Defective speech	2		2
Adenoids, tonsils, throat trouble	2		2
Crippled (various types)	1		1
Ill health, general	7	6	13
Mental:			
Mental dulling and mental defect	28	18	46
Affective deviation	3		3
Psychopathic states	2		2
Epilepsy	1		1
All other neuro-mental disorders	1		1
Total	86	46	132
1 boy crippled to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 34.8.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	9	10	19
Child has relative in community with neuro-mental disorder	2	1	3
Child entitled to relief by crippled children's law	2		2

Causes.	Boys.	Girls.	Total.
COLUMBIA COUNTY.			
Parental:			
Heredity and constitutional inferiority	2	1	3
Loss of one or both parents (including divorce)	2	1	3
Indifference to child's welfare	1	1	2
Lack of home training	3		3
Child not kept in school		1	1
Irregular attendance	2	1	3
Economic:			
Poor home and living conditions	2		2
Parental poverty	1		1
Moved frequently	2	8	10
Environmental:			
Entered school late (various reasons)	3	3	6
Foreign born; parents, child; home language	4	3	7
Lived long distance from school	2	1	3
Lack of school advantages	1	4	5
Inadequate instruction	2	2	4
Miscellaneous:			
Indian blood		1	1
Cause undifferentiated	1	1	2
No cause assigned	3	2	5
Temperamental:			
Bad habits, bad conduct, lazy	2	1	3
Carless, indifferent, inattentive	3	1	4
Poor application, dreamer, other interests	1	1	2
Bashful, timid, self-conscious	2		2
Physical:			
Undeveloped	1		1
Undernourished	1		1
Too rapid growth		1	1
Tuberculosis	1		1
Defective vision (eye disorders)	3		3
Defective hearing (ear disorders)		1	1
Defective teeth	1		1
Defective speech	1	1	2
Adenoids, tonsils, throat trouble	5		5
Ill health, general	3	3	6
Bad sex habits	3	3	6
Mental:			
Mental dulling and mental defect	32	14	46
Affective deviation	2	2	4
Chorea, all forms	1		1
Epilepsy		1	1
All other neuro-mental disorders		1	1
Total	93	60	153
1 boy deaf, 1 girl feeble-minded, both to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 30.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	12	9	21
Child has relative in community with neuro-mental disorder	13	2	15
Child entitled to relief by crippled children's law	2	1	3
COOS COUNTY.			
Parental:			
Heredity and constitutional inferiority	2	2	4
Loss of one or both parents (including divorce)	7	5	12
Indifference to child's welfare	6	4	10
Lack of home training	2	2	4
Child not kept in school	9	1	10
Irregular attendance	10	7	17
Economic:			
Poor home and living conditions	7	5	12
Parental poverty	2	1	3
No opportunity, child	5		5
Child kept home to work	4		4
Moved frequently	9	12	21
Environmental:			
Entered school late (various reasons)	8	2	10
Sickness in family		1	1
Foreign born; parents, child; home language	2	2	4
Lived long distance from school	1	4	5
No school available	4		4
Inadequate instruction	2		2
Lax enforcement of truancy laws	2		2
Miscellaneous:			
Indian blood	2	1	3
Cause undifferentiated	2	1	3
No cause assigned	25	11	36

Causes.	Boys.	Girls.	Total.
COOS COUNTY—Continued.			
Temperamental:			
Bad habits, bad conduct, lazy	3		3
Careless, indifferent, inattentive	3	1	4
Poor application, dreamer, other interests		1	1
Physical:			
Undeveloped	1		1
Undernourished	3	1	4
Too rapid growth		1	1
Tuberculosis	2	1	3
Defective vision (eye disorders)	2	2	4
Defective hearing (ear disorders)	5	1	6
Defective speech	4		4
Adenoids, tonsils, throat trouble	10	5	15
Crippled (various types)	1		1
Ill health, general	10	8	18
Mental:			
Mental dulling and mental defect	67	30	97
Affective deviation	2	1	3
Psychopathic states	2		2
Epilepsy	1		1
All other neuro-mental disorders	1	1	2
Total	228	114	342
1 girl blind, 1 boy and 1 girl deaf, 1 girl crippled, 1 boy and 1 girl feeble-minded, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 28.6.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	73	37	110
Child has relative in community with neuro-mental disorder	27	12	39
Child entitled to relief by crippled children's law	12	6	18
CROOK COUNTY.			
Parental: Heredity and constitutional inferiority	2	2	4
Economic: No opportunity, child		4	4
Environmental:			
Foreign born; parents, child; home language	1		1
No school available	1	1	2
Miscellaneous:			
Cause undifferentiated	1	1	2
No cause assigned	2	2	4
Physical:			
Defective vision (eye disorders)	1	1	2
Defective speech	2		2
Adenoids; tonsils; throat trouble	1		1
Ill health, general	1	3	4
Mental:			
Mental dulling and mental defect	9	8	17
Affective deviation	1		1
Total	22	22	44
Number of children mentally or physically defective to such an extent as to be unable to acquire an education. No information by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 38.6.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	12	12	24
Child has relative in community with neuromental disorder	3	3	6
Child entitled to relief by crippled childrens' law	2		2
CURRY COUNTY.			
Parental:			
Indifference to child's welfare	1		1
Lack of home training	2		2
Child not kept in school	4	1	5
Irregular attendance	6	4	10
Economic:			
No opportunity, child	2		2
Child kept home to work	1		1
Environmental:			
Entered school late (various reasons)	1	1	2
No school available	2		2
Lack of school advantages		1	1
Irregular sessions	3	3	6
Temperamental: Bad habits, bad conduct, lazy	1		1
Physical:			
Adenoids, tonsils, throat trouble	2	2	4
Ill health, general		2	2

Causes.	Boys.	Girls.	Total.
CURRY COUNTY—Continued.			
Mental:			
Mental dulling and mental defect	5	3	8
Affective deviation	1		1
Epilepsy		1	1
Total	31	18	49
Number of children mentally or physically defective to such an extent as to be unable to acquire an education. No information by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect 16.3.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	10	5	15
Child has relative in community with neuromental disorder	4	2	6
Child entitled to relief by crippled children's law	1		1
DESCHUTES COUNTY.			
Parental:			
Heredity and constitutional inferiority	2		2
Loss of one or both parents (including divorce)	4		4
Indifference to child's welfare	2		2
Lack of home training	1	1	2
Economic:			
No opportunity, child	2		2
Child kept home to work		4	4
Moved frequently	1		1
Environmental: Sickness in family		1	1
Miscellaneous: Cause undifferentiated	1	1	2
Physical:			
Tuberculosis	1		1
Defective vision (eye disorders)	2		2
Ill health, general	1		1
Mental:			
Mental dulling and mental defect	10	4	14
Affective deviation	1		1
Psychopathic states	1		1
Total	29	11	40
Number of children mentally and physically defective to such an extent as to be unable to acquire an education. No information by county superintendent. Percentage of over-age for grade pupils who showed signs of mental dullness or mental defect, 35.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	5	1	6
Child has relative in community with neuromental disorder	7		7
Child entitled to relief by crippled children's law	4	1	5
DOUGLAS COUNTY.			
Parental:			
Loss of one or both parents (including divorce)	1		1
Lack of home training	3	3	6
Child not kept in school		2	2
Irregular attendance	7	6	13
Economic:			
Poor home and living conditions	1		1
No opportunity, child	5	11	16
Moved frequently	6	2	8
Environmental:			
Entered school late (various reasons)		4	4
Lived long distance from school		1	1
Poor, dangerous, or mountainous roads	1	1	2
Lack of school advantages	2	3	5
Irregular sessions	2		2
Inadequate instruction	2	1	3
Miscellaneous:			
Cause undifferentiated	1		1
No cause assigned	5	2	7
Temperamental:			
Bad habits, bad conduct, lazy	1		1
Careless, indifferent, inattentive	2	2	4
Poor application, dreamer, other interests	2	2	4
Physical:			
Undeveloped	1		1
Undernourished	1		1
Defective vision (eye disorders)	2	2	4
Defective hearing (ear disorders)	1	1	2
Defective speech	1		1
Adenoids, tonsils, throat trouble	7	5	12
Ill health, general	7	2	9

Causes.	Boys.	Girls.	Total.
DOUGLAS COUNTY—Continued.			
Mental:			
Mental dulling and mental defect	38	20	58
Affective deviation	1	1	2
Psychopathic states	3	1	4
Total	103	72	175
Number of children mentally and physically defective to such an extent as to be unable to acquire an education. No information by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 33.2.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	39	38	77
Child has relative in community with neuromental disorder	8	7	15
Child entitled to relief by crippled children's law	8	6	14
GILLIAM COUNTY.			
Parental:			
Lack of home training	1		1
Child not kept in school	1	2	3
Irregular attendance	1	2	3
Economic:			
No opportunity, child	1		1
Child kept home to work	1	1	2
Environmental:			
Entered school late (various reasons)		3	3
Lived long distance from school	1	2	3
Temperamental: Bad habits, bad conduct, lazy	2		2
Physical:			
Undeveloped	1		1
Defective vision (eye disorders)	2	1	3
Adenoids, tonsils, throat trouble		1	1
Ill health, general	2	1	3
Mental:			
Mental dulling and mental defect	7	7	14
Psychopathic states	2		2
Total	22	20	42
Number of children mentally and physically defective to such an extent as to be unable to acquire an education. No information by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 33.3.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	8	5	13
Child has relative in community with neuromental disorder		3	3
GRANT COUNTY.			
Parental:			
Lack of home training	1		1
Irregular attendance	1	6	7
Economic:			
No opportunity, child		1	1
Child kept home to work	2	1	3
Environmental:			
Entered school late (various reasons)	3		3
Lived long distance from school	1	1	2
Miscellaneous: No cause assigned	2	2	4
Temperamental:			
Bad habits, bad conduct, lazy	1	1	2
Bashful, timid, self-conscious		1	1
Physical:			
Undernourished	1	1	2
Defective hearing (ear disorders)	1		1
Defective speech	1		1
Ill health, general	1	3	4
Mental: Mental dulling and mental defect	5	2	7
Total	20	19	39
One girl feeble-minded to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 17.9.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	5	2	7
Child has relative in community with neuromental disorder	1		1
Child entitled to relief by crippled children's law	2	1	3

Causes.	Boys.	Girls.	Total.
HARNEY COUNTY.			
Parental:			
Indifference to child's welfare		1	1
Irregular attendance	1		1
Miscellaneous: No cause assigned	23	12	35
Temperamental: Careless, indifferent, inattentive	1		1
Physical:			
Defective hearing (ear disorders)	1		1
Defective speech		1	1
Crippled (various types)	1		1
Ill health, general	2	3	5
Mental: Mental dulling and mental defect	8	8	16
Total	37	25	62
Number of children mentally and physically defective to such an extent as to be unable to acquire an education. No information by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 25.8.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	10	10	20
Child has relative in community with neuromental disorder	3	1	4
Child entitled to relief by crippled children's law	1	1	2
HOOD RIVER COUNTY.			
Parental:			
Heredity and constitutional inferiority	3	2	5
Indifference to child's welfare		1	1
Child not kept in school	1		1
Irregular attendance	3		3
Economic:			
Poor home and living conditions	1		1
Child kept home to work	1		1
Moved frequently	2	1	3
Environmental:			
Entered school late (various reasons)	1	2	3
Foreign born; parents, child; home language	2	1	3
Miscellaneous:			
Cause undifferentiated		1	1
No cause assigned	4		4
Temperamental: Bad habits; bad conduct; lazy	3		3
Physical:			
Undernourished	2	2	4
Defective vision (eye disorders)	1	1	2
Defective hearing (ear disorders)		1	1
Defective speech	2	2	4
Adenoids, tonsils, throat trouble	3	1	4
Crippled (various types)	1		1
Ill health, general	1	3	4
Mental:			
Mental dulling and mental defect	17	11	28
Affective deviation	1		1
Psychopathic states	1	1	2
Epilepsy	1		1
All other neuromental disorders	1		1
Total	52	30	82
Number of children mentally and physically defective to such an extent as to be unable to acquire an education, none. Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 34.1.			
Heredity:			
Child has brother, sister or other relative in school who is also over age for grade	9	2	11
Child has relative in community with neuromental disorder	8	1	9
Child entitled to relief by crippled children's law	1		1
JACKSON COUNTY.			
Parental:			
Heredity and constitutional inferiority	1	1	2
Loss of one or both parents (including divorce)	1		1
Indifference to child's welfare		1	1
Lack of home training	1		1
Child not kept in school	2		2
Irregular attendance	6	6	12
Economic:			
Poor home and living conditions	3	4	7
No opportunity, child	2	4	6
Child kept home to work	2	1	3
Moved frequently	3	3	6

Causes.	Boys.	Girls.	Total.
JACKSON COUNTY—Continued.			
Environmental:			
Entered school late (various reasons)	4	6	10
Foreign born; parents, child; home language	1	1	2
Lived long distance from school	2	3	5
Poor, dangerous, or mountain roads		4	4
No school available	3		3
Lack of school advantages	2	4	6
Inadequate instruction	1		1
Lax enforcement of truancy laws	2		2
Miscellaneous:			
Cause undifferentiated	4	3	7
No cause assigned	19	9	28
Temperamental: Poor application, dreamer, other interests		1	1
Physical:			
Defective vision (eye disorder)	4	1	5
Adenoids, tonsils, throat trouble	2		2
Crippled (various types)		2	2
Ill health, general	11	3	14
Mental:			
Mental dulling and mental defect	26	9	35
Affective deviation	3		3
Psychopathic states	2	1	3
All other neuromental disorders	2		2
Total	109	67	176
2 boys and 1 girl, mental defective; 1 boy crippled, all to such an extent as to be unable to acquire an education. Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 19.8.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	22	21	43
Child has relative in community with neuromental disorder	4	3	7
Child entitled to relief by crippled children's law	1	4	5
JEFFERSON COUNTY.			
Parental:			
Heredity and constitutional inferiority	1	2	3
Irregular attendance	2	2	4
Economic:			
No opportunity, child	1		1
Child kept home to work	1		1
Environment: Entered school late (various reasons)	1	1	2
Temperamental:			
Careless, indifferent, inattentive	1		1
Poor application, dreamer, other interests		1	1
Physical:			
Undernourished		2	2
Defective vision (eye disorder)	1		1
Defective speech	1		1
Adenoids, tonsils, throat trouble	1		1
Ill health, general	1		1
Mental:			
Mental dulling and mental defect	7	2	9
Psychopathic states	1		1
Epilepsy	1		1
Total	20	10	30
Number of children mentally and physically defective to such an extent as to be unable to acquire an education, none. Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 30.			
Heredity:			
Child has brother, sister or other relative in school who is also over-age for grade	3	6	9
Child has relative in community with neuromental disorder	3	3	6
Child entitled to relief by crippled children's law		2	2
JOSEPHINE COUNTY.			
Parental:			
Heredity and constitutional inferiority	1		1
Indifference to child's welfare	3	1	4
Lack of home training	3		3
Irregular attendance	2	1	3
Economic:			
Poor home and living conditions	1		1
No opportunity, child		1	1
Child kept home to work	1		1
Moved frequently	2		2
Environmental:			
Entered school late (various reasons)	2	1	3
Lived long distance from school	1	2	3
Lack of school advantages	2	1	3
Inadequate instruction	1	1	2

Causes.	Boys.	Girls.	Total.
JOSEPHINE COUNTY—Continued.			
Miscellaneous:			
Cause undifferentiated	1	1	2
No cause assigned	2	3	5
Temperamental:			
Bad habits, bad conduct, lazy	1		1
Careless, indifferent, inattentive	4	1	5
Physical:			
Undeveloped		1	1
Adenoids, tonsils, throat trouble		1	1
Crippled (various types)	1		1
Ill health, general	3	3	6
Mental:			
Mental dulling and mental defect	9	9	18
Affective deviation	3	1	4
Psychopathic states		1	1
Epilepsy	2		2
Total	45	29	74
1 girl feeble-minded to such an extent as to be unable to acquire an education. Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 24.			
Heredity:			
Child has brother, sister or other relative in school who is also over age for grade	22	8	30
Child has relative in community with neuromental disorder	7	5	12
Child entitled to relief by crippled children's law	4	4	8
KLAMATH COUNTY.			
Parental:			
Heredity and constitutional inferiority		1	1
Lack of home training	1		1
Child not kept in school		1	1
Irregular attendance	1	2	3
Economic:			
No opportunity (child)	3	6	9
Child kept home to work	1		1
Moved frequently		1	1
Environmental:			
Lack of school advantages	1		1
Lax enforcement of truancy laws	4	3	7
Miscellaneous: Cause undifferentiated		1	1
Temperamental: Poor application, dreamer, other interests		1	1
Physical:			
Undeveloped	1		1
Undernourished	1		1
Crippled (various types)	1		1
Ill health, general	3	2	5
Mental:			
Mental dulling and mental defect	11	3	14
Affective deviation	1	1	2
Chorea, all forms	1		1
Epilepsy	1	1	2
Total	33	24	57
Number of children mentally and physically defective to such an extent as to be unable to acquire an education.—No information by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 24.5.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	18	10	28
Child has relative in community with neuromental disorder	8	4	12
Child entitled to relief by crippled children's law	3		3
LAKE COUNTY.			
Parental:			
Child not kept in school		2	2
Irregular attendance		4	4
Economic:			
Poor home and living conditions	1		1
No opportunity (child)	1		1
Child kept home to work	1		1
Moved frequently	1	1	2
Environmental:			
Entered school late (various reasons)	2	1	3
Foreign born, parents, child, home language	1		1
Lived long distance from school		1	1
Miscellaneous: No cause assigned		3	3
Temperamental: Bad habits, bad conduct, lazy	1		1

Causes.	Boys.	Girls.	Total.
LAKE COUNTY—Continued.			
Physical:			
Defective vision (eye disorders)	1		1
Defective speech	1		1
Adenoids, tonsils, throat trouble	3	1	4
Crippled (various types)	1		1
Ill health, general		1	1
Mental:			
Mental dulling and mental defect	9	2	11
Affective deviation	2		2
Chorea, all forms	1		1
Total	26	16	42
Number of children mentally and physically defective to such an extent as to be unable to acquire an education.—No information by county school superintendent. Percentage of over-age for grade who showed signs of metal dulling or mental defect, 26.8.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	10	4	14
Child has relative in community with neuromental disorder	3		3
Child entitled to relief by crippled children's law	4	1	5
LANE COUNTY.[4]			
[Conducted by Prof. Burchard W. De Busk, Ph. D., school of education; Mozelle Hair, B. A., secretary of extension teaching; and L. C. Douglass, B. A., graduate instructor in education, extension division, University of Oregon; and Miss Mary Brownell, Lane County health nurse, acting as special field investigators in collaboration with the county and city school superintendents and the teachers of the public schools.]			
Parental:			
Heredity and constitutional inferiority	16	9	25
Loss of one or both parents (including divorce)	12	7	19
Indifference to child's welfare	7	7	14
Lack of home training	5	2	7
Child not kept in school	10	4	14
Irregular attendance	11	11	22
Economic:			
Poor home and living conditions	6	5	11
Paternal poverty	4		4
No opportunity, child	9	6	15
Child kept home to work	5	2	7
Moved frequently	10	17	27
Environmental:			
Entered school late (various reasons)	12	17	29
Sickness in family	1	1	2
Foreign born: parents, child: home language	3	2	5
Lived long distance from school	5	6	11
Poor, dangerous, or mountain roads	7	3	10
No school available	1	3	4
Lack of school advantages	3	5	8
Irregular sessions	1	1	2
Inadequate instruction	11	4	15
Lax enforcement of truancy laws	3		3
Miscellaneous:			
Indian blood	1	1	2
Cause undifferentiated	12	3	15
No cause assigned	21	10	31
Temperamental:			
Bad habits, bad conduct, lazy	10		10
Careless, indifferent, and inattentive	10	2	12
Poor application; dreamer; other interests	10	6	16
Bashful, timid, self-conscious		2	2
Truancy	1		1
Physical:			
Undeveloped	8	2	10
Undernourished	6	1	7
Tuberculosis		3	3
Defective vision (eye disorders)	13	11	24
Defective hearing (ear disorders)	9	2	11
Defective teeth	4		4
Defective speech	4	3	7
Adenoids; tonsils; throat trouble	18	10	28
Crippled (various types)	6	5	11
Ill health, general	29	29	58

[4] Note by director: In many of the 36 counties of the State there are school children with Indian blood some of whom are over age for grade. When the cause of such retardation was definitely known to be something other than the mere fact of Indian blood the cause was recorded under the appropriate heading; for instance, "ill health". Cases of retardation were recorded under "Indian blood" only when such was given as the sole cause.

Causes.	Boys.	Girls.	Total.
LANE COUNTY—Continued.			
Mental:			
Mental dulling and mental defect	130	86	216
Affective deviation	11	3	14
Psychopathic states	5	4	9
Chorea, all forms	1	1	2
Epilepsy	1	1	2
All other neuromental disorders	6	7	13
Total	458	304	762
Four boys and 2 girls deaf; 2 boys and 2 girls feeble-minded, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 28.3.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	172	105	277
Child has relative in community with neuro-mental disorder	57	35	92
Child entitled to relief by crippled children's law	44	23	67
LINCOLN COUNTY.			
Parental:			
Heredity and constitutional inferiority	2	3	5
Loss of one or both parents (including divorce)	1	3	4
Child not kept in school	2		2
Irregular attendance	3	2	5
Economic:			
Poor home and living conditions	1		1
No opportunity, child	2		2
Child kept home to work	1		1
Moved frequently	2	1	3
Environmental:			
Entered school late (various reasons)	16	10	16
Foreign born; parents, child; home language		1	1
Lived long distance from school	1		1
Poor, dangerous, or mountain roads	1		1
No school available	2	1	3
Lack of school advantages	1	1	2
Irregular sessions	4		4
Inadequate instruction	3		3
Miscellaneous:			
Indian blood	7	5	12
Cause undifferentiated	3	2	5
No cause assigned	8	6	14
Temperamental:			
Careless; indifferent; inattentive	1		1
Bashful; timid; self-conscious	1		1
Physical:			
Undernourished	1		1
Defective vision (eye disorders)	2		2
Defective hearing (ear disorders)	1		1
Defective teeth	1		1
Adenoids; tonsils; throat trouble	3	4	7
Crippled (various types)	1		1
Ill health, general	7	4	11
Mental:			
Mental dulling and mental defect	27	15	42
Affective deviation	3		3
Epilepsy	2		2
All other neuromental disorders	2	1	3
Total	102	59	161
Five boys feeble-minded, 1 boy blind, 1 girl deaf, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 26.2.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	35	17	52
Child has relative in community with neuromental disorder	3	1	4
Child entitled to relief by crippled children's law	10	3	13
LINN COUNTY.			
Parental:			
Heredity and constitutional inferiority	2	1	3
Loss of one or both parents (including divorce)	1	6	7
Indifference to child's welfare	5	1	6
Lack of home training	3	2	5
Child not kept in school	4		4
Irregular attendance	9	4	13
Economic:			
Poor home and living conditions	4	1	5
Parental poverty	2		2

Causes.	Boys.	Girls.	Total.
LINN COUNTY—Continued.			
Economic—Continued.			
No opportunity, child	4	2	6
Child kept home to work	3	1	4
Moved frequently	10	6	16
Environmental:			
Entered school late (various reasons)	10	7	17
Lived long distance from school	4	3	7
Inadequate instruction	2		2
Miscellaneous:			
Cause undifferentiated	7	2	9
No cause assigned	19	18	37
Temperamental:			
Bad habits, bad conduct, lazy	4		4
Careless, indifferent, inattentive	5	4	9
Poor application, dreamer, other interests	5	3	8
Physical:			
Undeveloped		2	2
Undernourished	1	1	2
Too rapid growth	1		1
Tuberculosis	2	3	5
Defective vision (eye disorders)	6	3	9
Defective speech	4		4
Adenoids; tonsils; throat trouble	4	1	5
Ill health, general	15	19	34
Mental:			
Mental dulling and mental defect	45	22	67
Affective deviation	4		4
All other neuromental disorders	3	4	7
Total	188	116	304
1 girl blind and 1 girl deaf, both to such an extent as to be unable to acquire an education—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or metal defect, 21.7.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	52	40	92
Child has relative in the community with neuromental disorder	7	5	12
Child entitled to relief by crippled children's law	14	8	22
MALHEUR COUNTY.			
Parental:			
Loss of one or both parents (including divorce)	1	3	4
Lack of home training	1		1
Child not kept in school	1		1
Irregular attendance	2	1	3
Economic:			
Poor home and living conditions	2		2
No opportunity, child	4	4	8
Child kept home to work	1		1
Moved frequently	1		1
Environmental:			
Entered school late (various reasons)		3	3
Foreign born, parents, child; home language	1		1
Lived long distance from school	3		3
Lack of school advantages	1	1	2
Inadequate instruction		1	1
Miscellaneous: No cause assigned		5	5
Temperamental: Bad habits, bad conduct, lazy	1		1
Physical:			
Undeveloped	1		1
Too rapid growth	1		1
Defective vision (eye disorders)	2		2
Adenoids; tonsils; throat trouble	2	1	3
Crippled (various types)	1	2	3
Ill health, general	2	3	5
Mental:			
Mental dulling and mental defect	13	8	21
Affective deviation	2		2
Chorea, all forms		1	1
Total	43	33	76
Number of children mentally or physically defective to such an extent as to be unable to acquire an education—No information by county school superintendent. Note by the director: In a certain school district touching the Nevada border there were no English-speaking families. This illustrates the need for State, county, and city school officials to be on the lookout for foci in all communities where the influence of a foreign language in the daily home life of the school child, to the exclusion of the English language, may act as a definite handicap to normal expected age-grade school progress. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 27.6.			

Causes.	Boys.	Girls.	Total.
MALHEUR COUNTY—Continued.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	18	15	33
Child has relative in community with neuromental disorder	1	2	3
Child entitled to relief by crippled children's law	1	1	5
MARION COUNTY.			
[Table for Marion County does not include any children in the State institutions or in the institution schools located in this county.]			
Parental:			
Heredity and constitutional inferiorty	2	1	3
Loss of one or both parents (including divorce)	3	3	6
Indifference to child's welfare	5	3	8
Lack of home training	9	....	9
Child not kept in school	7	2	9
Irregular attendance	9	6	15
Economic:			
Poor home and living conditions	4	5	9
Parental poverty	1	1	2
No opportunity, child	1	4	5
Child kept home to work	3	1	4
Moved frequently	15	5	20
Environmental:			
Entered school late (various reasons)	10	8	18
Sickness in family	....	1	1
Foreign born: parents, child; home language	2	....	2
Lived long distance from school	1	....	1
Poor, dangerous, or mountain roads	1	....	1
No school available	1	....	1
Lack of school advantages	....	2	2
Inadequate instruction	5	3	8
Miscellaneous:			
Cause undifferentiated	7	7	14
No cause assigned	11	11	22
Temperamental:			
Bad habits, bad conduct, lazy	2	....	2
Careless, indifferent, inattentive	10	....	10
Poor application, dreamer, other interests	3	....	3
Bashful, timid, self-conscious	1	1	2
Truancy	2	....	2
Physical:			
Undeveloped	4	2	6
Undernourished	4	1	5
Defective vision (eye disorders)	3	2	5
Defective hearing (ear disorders)	1	....	1
Defective speech	3	2	5
Adenoids, tonsils, throat trouble	8	3	11
Crippled (various types)	3	....	3
Ill health, general	12	12	24
Mental:			
Mental dulling and mental defect	54	26	80
Affective deviation	4	4	8
Psychopathic states	....	2	2
Epilepsy	....	1	1
All other neuromental disorders	6	4	10
Total	217	123	340
7 boys and 4 girls feeble-minded, 12 boys and 5 girls deaf, 4 boys and 2 girls blind, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 23.5.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	66	41	107
Child has relative in community with neuromental disorder	22	8	30
Child entitled to relief by crippled-children's law	18	13	31
MORROW COUNTY.			
Parental:			
Loss of one or both parents (including divorce)	....	2	2
Child not kept in school	1	1	2
Irregular attendance	4	1	5
Economic:			
Child kept home to work	1	....	1
Moved frequently	2	....	2
Environmental:			
Entered school late (various reasons)	1	....	1
Lived long distance from school	3	1	4
Temperamental:			
Bad habits, bad conduct, lazy	1	....	1
Careless, indifferent, inattentive	1	....	1
Truancy	2	....	2

Causes.	Boys.	Girls.	Total.
MORROW COUNTY—Continued.			
Physical:			
Undeveloped	3	2	5
Undernourished		1	1
Defective vision (eye disorders)	3		3
Defective hearing (ear disorders)	2		2
Defective speech	1		1
Adenoids, tonsils, throat trouble		1	1
Crippled (various types)	1		1
Ill health, general	3	1	4
Bad sex habits	3		3
Mental:			
Mental dulling and mental defect	13	10	23
Psychopathic states	1	1	2
All other neuromental disorders	1		1
Total	47	21	68
2 boys and 1 girl feeble-minded, 1 girl crippled, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 33.8.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	9	8	17
Child has relative in community with neuromental disorder	2	2	4
Child entitled to relief by crippled-children's law	4	2	6
MULTNOMAH COUNTY.			
[Conducted by Miss Ida M. Manley, principal Etna Center School, director of special classes, Portland, special field investigator, in collaboration with the county and city school superintendents, principals, and the teachers of the public schools.]			
Parental:			
Heredity and constitutional inferiority	57	51	108
Loss of one or both parents (including divorce)	69	34	103
Indifference to child's welfare	16	7	23
Lack of home training	21	7	28
Child not kept in school	37	31	68
Irregular attendance	51	48	99
Economic:			
Poor home and living conditions	30	14	44
Parental poverty	3	2	5
No opportunity, child	10	11	21
Child kept home to work	17	8	25
Moved frequently	168	127	295
Environmental:			
Entered school late (various reasons)	156	146	302
Sickness in family	10	23	33
Foreign born: parents, child; home language	141	135	276
Lived long distance from school	8	16	24
Poor, dangerous, or mountain roads	4	4	8
No school available	15	14	29
Lack of school advantages	29	24	53
Irregular sessions	10	9	19
Inadequate instruction	43	31	74
Lax enforcement of truancy laws	1	2	3
Miscellaneous:			
Cause undifferentiated	33	32	65
No cause assigned	247	158	405
Temperamental:			
Bad habits, bad conduct, lazy	56	6	62
Careless, indifferent, inattentive	42	5	47
Poor application, dreamer, other interests	66	21	87
Bashful, timid, self-conscious	10	5	15
Truancy	55	31	86
Physical:			
Undeveloped	45	18	63
Undernourished	14	10	24
Too rapid growth	6	1	7
Tuberculosis	6	4	10
Defective vision (eye disorders)	43	45	88
Defective hearing (ear disorders)	37	17	54
Defective teeth	6	4	10
Defective speech	19	7	26
Adenoids, tonsils, throat trouble	40	32	72
Crippled (various types)	43	24	67
Ill health, general	253	286	539
Bad sex habits	2	1	3
Mental:			
Mental dulling and mental defect	529	343	872
Affective deviation	31	12	43
Psychopathic states	23	21	44

Causes.	Boys.	Girls.	Total.
MULTNOMAH COUNTY—Continued.			
Mental—Continued.			
Chorea, all forms	4	4	8
Epilepsy	6	2	8
All other neuromental disorders	30	20	50
Total	2,542	1,853	4,395
31 boys and 22 girls feeble-minded, 6 boys and 3 girls blind, 15 boys and 16 girls deaf, 1 boy and 1 girl epileptic, 1 boy chorea, 1 boy "nervous," 16 boys and 6 girls crippled, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils (including all those for whom "no cause" was assigned) who showed signs of mental dulling or mental defect, 19.84. Percentage of over-age for grade pupils (excluding all cases where "no cause" was assigned) who showed signs of mental dulling or mental defect, 21.85.			
Child entitled to relief by crippled-children's law	125	69	194
POLK COUNTY.[5]			
Parental:			
Heredity and constitutional inferiority	2	3	5
Loss of one or both parents (including divorce)		1	1
Child not kept in school	1	4	5
Irregular attendance	7	2	9
Economic:			
No opportunity, child	2	1	3
Child kept home to work	3	1	4
Moved frequently	3	4	7
Environmental:			
Entered school late (various reasons)	9	11	20
Sickness in family	2	2	4
Foreign born: parents, child; home language	6	4	10
Lived long distance from school	1	1	2
Poor, dangerous or mountain roads	3	2	5
No school available	2	1	3
Lack of school advantages		2	2
Inadequate instructions	3	2	5
Lax enforcement of truancy laws		1	1
Miscellaneous:			
Indian blood	(6)	(6)	(6)
Cause undifferentiated	3	1	4
No cause assigned	2	2	4
Temperamental:			
Careless, indifferent, inattentive	2		2
Poor application, dreamer, other interests	1	1	2
Physical:			
Undeveloped	2	1	3
Undernourished	1		1
Defective vision (eye disorders)	4	4	8
Defective hearing (ear disorders)	1	1	2
Defective speech		2	2
Adenoids, tonsils, throat trouble	3	1	4
Crippled (various types)		2	2
Ill health, general	13	6	19
Mental:			
Mental dull and mental defect	18	11	29
Affective deviation	3		3
Psychopathic states	1	2	3
Epilepsy		2	2
Total	98	78	176
2 boys feeble-minded, 2 girls crippled, 3 girls and 3 boys (4 of these deaf children are all in one family) deaf, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 16.3.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	33	34	67
Child has relative in community with neuromental disorder	2	5	7
Child entitled to relief by children's crippled law	4	7	11

[5] An illustration of casual factors affecting whole family groups which produce subnormal, inefficient conduct as demonstrated by retardation in school work: One school district had 24 overage for grade pupils; 17 of these retarded pupils (7 boys and 10 girls) were brothers and sisters. Such foci for school retardation should be investigated as to basic causes for such conditions if the children are to receive their inalienable rights for full mental, physical, and sociological development. Fields for such investigations comprise parental stock, environmental obstacles, pedagogic adequacy, physical and mental handicaps of pupils, and finally the enforcement of all laws calculated to guarantee to every child a chance to grow up a healthy, happy, contented, and constructive citizen.

[6] There were 4 boys and 8 girls of Indian blood in the above list of over-age for graded pupils. The cause of their retardation was placed under some one of the other headings appropriate to each individual case. See remarks on "Indian blood" under Lane County.

Causes.	Boys.	Girls.	Total.
SHERMAN COUNTY.			
Parental:			
Loss of one or both parents (including divorce)	2	1	3
Child not kept in school		1	1
Irregular attendance		2	2
Economic:			
No opportunity, child		1	1
Moved frequently	5		5
Environmental:			
Entered school late (various reasons)	2	3	5
Lived long distance from school		1	1
Lack of school advantages	1	1	2
Inadequate instruction	2		2
Lax enforcement of truancy laws	2		2
Temperamental: Poor application, dreamer, other interests	1		1
Physical:			
Defective vision (eye disorders)	2	1	3
Defective speech	1		1
Crippled (various types)		1	1
Ill health, general	1	1	2
Mental:			
Mental dulling and mental defect	7	3	10
Affective deviation		1	1
Total	26	17	43
Number of children mentally and physically defective to such an extent as to be unable to acquire an education. No information by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 23.2.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	7	6	13
Child has relative in community with neuromental disorder	2	1	3
Child entitled to relief by crippled children's law	3	3	6
TILLAMOOK COUNTY.			
Parental:			
Heredity and constitutional inferiority	1	2	3
Loss of one or both parents (including divorce)	3		3
Indifference to child's welfare	1	2	3
Child not kept in school		1	1
Economic:			
Child kept home to work	2	1	3
Moved frequently	2	1	3
Environmental:			
Entered school late (various reasons)	1		1
Sickness in family	1		1
Foreign born; parents, child; home language	1		1
Lived long distance from school		1	1
No school available		1	1
Lack of school advantages		1	1
Inadequate instruction	2	1	3
Lax enforcement of truancy laws		1	1
Miscellaneous: No cause assigned	1		1
Temperamental:			
Bad habits; bad conduct; lazy	1		1
Careless, indifferent, inattentive	3	2	5
Physical:			
Undeveloped	3	2	5
Defective vision (eye disorders)	1		1
Defective hearing (ear disorders)	1	1	2
Defective speech		3	3
Adenoids, tonsils, throat trouble	3	1	4
Crippled (various types)	1		1
Ill health, general	1	2	3
Mental:			
Mental dulling and mental defect	10	6	16
Affective deviation	1		1
Total	40	29	69
Number of children mentally and physically defective to such an extent as to be unable to acquire an education. No information by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defects, 23.1.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	16	9	25
Child has relative in community with neuromental disorder	1		1
Child entitled to relief by crippled children's law	2	5	7

Causes.	Boys.	Girls.	Total.
UMATILLA COUNTY.			
Parental:			
Heredity and constitutional inferiority	8	4	12
Loss of one or both parents (including divorce)	5	8	13
Lack of home training	1		1
Child not kept in school	1	1	2
Irregular attendance	4		4
Economic:			
Poor home and living conditions	4	2	6
No opportunity, child	2	2	4
Child kept home to work	2		2
Moved frequently	2	1	3
Environmental:			
Entered school late (various reasons)	4		4
Foreign born; parents, child; home language	4	5	9
Lived long distance from school	4	7	11
Lack of school advantages	1		1
Inadequate instruction	4	2	6
Miscellaneous:			
Indian blood	1	4	5
No cause assigned	46	[7] 36	[7] 82
Temperamental:			
Bad habits; bad conduct; lazy	2		2
Poor application, dreamer, other interests		1	1
Physical:			
Tuberculosis	1		1
Defective vision (eye disorders)	4		4
Defective hearing (ear disorders)		1	1
Crippled (various types)	2		2
Ill health, general	3	4	7
Mental:			
Mental dulling and metal defect	30	15	45
Affective deviation	2		2
Epilepsy	1		1
All other neuromental disorders	1		1
Total	139	93	232
One boy and 1 girl mentally defective to such an extent as to be unable to acquire an education. Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 15.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	33	27	60
Child has relative in community with neuromental disorder	2	1	3
Child entitled to relief by crippled children's law	6	1	7
UNION COUNTY.			
Parental:			
Heredity and constitutional inferiority	3	2	5
Indifference to child's welfare		2	2
Lack of home training	1		1
Child not kept in school		2	2
Irregular attendance	5	4	9
Economic:			
No opportunity, child	1	4	5
Child kept home to work	5	1	6
Moved frequently	1		1
Environmental:			
Entered school late (various reasons)	1	1	2
Lived long distance from school		2	2
Poor, dangerous, or mountain roads	1	2	3
No school available		1	1
Lack of school advantages	2	2	4
Irregular sessions		1	1
Miscellaneous:			
Cause undifferentiated	1		1
No cause assigned	1	2	3
Temperamental:			
Careless, indifferent, inattentive	1		1
Bashful, timid, self-conscious		1	1
Physical:			
Tuberculosis	1		1
Defective hearing (ear disorders)	2	1	3
Defective speech		1	1
Adenoids, tonsils, throat trouble	1		1
Ill health, general	6	2	8
Bad sex habits		3	3

[7] An unusual number of cases were sent in from one school with "no cause" assigned. An intimate knowledge of fundamental causes for retardation of children in their school work is highly desirable. We must be able to discern the causes of failure in order to be able to correct them. The adequate diagnosis of retardation should be part of the routine daily work of every educator, assisted by the collabcration of parents, physicians, school nurses, and county health officers.

Causes.	Boys.	Girls.	Total.
UNION COUNTY—Continued.			
Mental:			
Mental dulling and mental defect	14	9	23
Affective deviation	1	....	1
Psychopathic states	2	....	2
Epilepsy	1	....	1
All other neuromental disorders	1	1	2
Total	52	44	96
One girl deaf to such an extent as to be unable to acquire an education. Report by county school superintendent. Percentage of over-age for grade pupil who showed signs of mental dulling or mental defect, 23.9.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	9	19	28
Child has relative in community with neuromental disorder	6	1	7
Child entitled to relief by crippled children's law	3	3	6
WALLOWA COUNTY.			
Parental:			
Heredity and constitutional inferiority	1	....	1
Lack of home training	1	....	1
Child not kept in school	1	....	1
Irregular attendance	2	1	3
Economic:			
No opportunity, child	....	4	4
Moved frequently	2	3	5
Environmental:			
Entered school late (various reasons)	....	1	1
No school available	6	3	9
Lack of school advantages	....	1	1
Irregular sessions	1	2	3
Lax enforcement of truancy laws	1	....	1
Miscellaneous: No cause assigned	4	1	5
Temperamental:			
Bad habits, bad conduct, lazy	5	....	5
Careless, indifferent, inattentive	....	1	1
Poor application, dreamer, other interests	2	....	2
Physical:			
Undeveloped	1	....	1
Undernourished	1	....	1
Defective vision (eye disorders)	2	....	2
Defective hearing (ear disorders)	2	2	4
Adenoids, tonsils, throat	1	1	2
Crippled (various types)	....	1	1
Ill health, general	4	8	12
Mental:			
Mental dulling and mental defect	11	7	18
All other neuromental disorders	1	....	1
Total	49	36	85
One girl deaf; 3 boys and 1 girl feeble-minded to such an extent as to be unable to acquire an education. Report by county superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 21.1.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	17	14	31
Child has relative in community with neuromental disorder	4	....	4
Child entitled to relief by crippled children's law	4	2	6
WASCO COUNTY.			
Parental:[8]			
Heredity and constitutional inferiority	5	3	8
Loss of one or both parents (including divorce)	2	1	3

[8] To show the human value behind just one of the figures on this chart, here is the real story of one of the retarded children who appears as one listed under the causes, "Parental, heredity, and constitutional inferiority." He is 11 years old, in the second grade, the son of a poor farmer who is spoken of in his community as "not bright," rather morose, and not successful in his farm work. You can just see that farm with its scraggy clearings and the unkempt house yard. The boy's mother was of a higher mental caliber, her disposition sunny, but she was perhaps overwhelmed by her surroundings and the hard facts of life. At any rate, the folks didn't think she was very successful as a housewife. There was one feeble-minded brother and another rather dull, who is known as mean and cruel to the cattle. The family lived up in the Cascade Mountains, where the smaller streams cut through canyons to reach the mighty Columbia River. It was all very rugged and, as roads were bad and the child and his brother lived over 5 miles from the nearest available school, they came and went on the old family horse. And so, as the family was poor, there wasn't much opportunity anyway. Here is one of many such cases where the child's retardation in school work depends upon many things, environmental, parental, and his own native ability or lack of ability. The bare home in the high, rugged hills, the bleak outlook in life, the morose, unsuccessful father, the retarded child, all point to some basic cause for this lack of happiness and success. In this particular child we believe it was due to the effect of his ancestral stock; the factors of heredity. In other cases it may be different. Think over carefully just what the various headings may mean in the case of each child. Don't think of these charts in terms of arithmetic but see the faces of the children behind each row of figures, the parents and homes behind each child.

Causes.	Boys.	Girls.	Total.
WASCO COUNTY—Continued.			
Parental—Continued.			
Lack of home training	1	....	1
Child not kept in school	9	2	11
Irregular attendance	5	5	10
Economic:			
No opportunity, child	2	1	3
Child kept home to work	2	2	4
Moved frequently	1	2	3
Environmental:			
Entered school late (various reasons)	2	4	6
Sickness in family	1	1	2
Lived long distance from school	3	....	3
Poor, dangerous, or mountain roads	2	3	5
Lack of school advantages	4	3	7
Irregular sessions	2	3	5
Miscellaneous: Cause undifferentiated	2	....	2
Temperamental:			
Careless; indifferent; inattentive	2	....	2
Poor application; dreamer; other interests	....	1	1
Physical:			
Undernourished	1	....	1
Tuberculosis	1	....	1
Defective hearing (ear disorders)	2	1	3
Defective speech	1	....	1
Adenoids, tonsils, throat trouble	1	....	1
Crippled (various types)	2	4	6
Ill health, general	3	1	4
Mental:			
Mental dulling and mental defect	19	10	29
Affective deviation	1	1	2
All other neuro-mental disorders	2	1	3
Total	78	49	127
2 boys and 2 girls crippled, 1 boy bad eyesight, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 23.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	24	25	49
Child has relative in community with neuro-mental disorder	9	6	15
Child entitled to relief by crippled children's law	5	5	10
WASHINGTON COUNTY.			
Parental:			
Heredity and constitutional inferiority	6	1	7
Loss of one or both parents (including divorce)	5	1	6
Indifference to child's welfare	3	7	10
Lack of home training	2	2	4
Child not kept in school	4	4	8
Irregular attendance	7	4	11
Economic:			
Parental poverty	1	....	1
No opportunity, child	6	3	9
Child kept home to work	4	2	6
Moved frequently	3	6	9
Environmental:			
Entered school late (various reasons)	2	3	5
Sickness in family	1	....	1
Foreign born: Parents, child; home language	3	3	6
Lived long distance from school	1	1	2
Lack of school advantages	3	2	5
Inadequate instruction	2	....	2
Miscellaneous:			
Cause undifferentiated	7	2	9
No cause assigned	3	....	3
Temperamental:			
Bad habits; bad conduct; lazy	4	....	4
Careless; indifferent; inattentive	1	2	3
Poor application; dreamer; other interests	8	1	9
Bashful; timid; self-conscious	....	1	1
Physical:			
Undernourished	3	....	3
Defective vision (eye disorders)	4	4	8
Defective hearing (ear disorders)	1	....	1
Defective teeth	2	1	3
Defective speech	1	....	1
Adenoids; tonsils; throat trouble	5	4	9
Crippled (various types)	1	1	2
Ill health, general	8	9	17
Bad sex habits	....	1	1

Causes.	Boys.	Girls.	Total.
WASHINGTON COUNTY—Continued.			
Mental:			
Mental dulling and mental defect	42	21	63
Affective deviation	2	3	5
Psychopathic states	1	....	1
Chorea, all forms	1	....	1
Epilepsy	1	1	2
All other neuro-mental disorders	2	1	3
Total	150	91	241
4 boys and 3 girls feeble-minded, 1 girl crippled, 1 boy deaf, 1 boy blind, all to such an extent as to be unable to acquire an education.—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 26.1.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	48	31	79
Child has relative in community with neuro-mental disorder	13	2	15
Child entitled to relief by crippled children's law	6	7	13
WHEELER COUNTY.[9]			
Parental:			
Heredity and constitutional inferiority	1	....	1
Child not kept in school	1	1	2
Irregular attendance	20	15	35
Economic:			
No opportunity, child	1	....	1
Moved frequently	....	1	1
Environmental:			
Lived long distance from school	....	2	2
Inadequate instruction	2	....	2
Lax enforcement of truancy laws	4	1	5
Miscellaneous: No cause assigned	....	1	1
Temperamental: Poor application; dreamer; other interests	1	1	2
Physical: Ill health, general	1	....	1
Mental:			
Mental dulling and mental defect	6	5	11
Epilepsy	1	1	2
Total	38	28	66
Number of children mentally and physically so defective as to be unable to acquire an education, "none reported."—Report by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 16.66.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	20	21	41
Child has relative in community with neuro-mental disorder	2	2	4
Child entitled to relief by crippled children's law	1	1	2
YAMHILL COUNTY.			
Parental:			
Heredity and constitutional inferiority	9	6	15
Loss of one or both parents (including divorce)	5	4	9
Indifference to child's welfare	1	....	1
Lack of home training	2	....	2
Child not kept in school	2	2	4
Irregular attendance	5	4	9
Economic:			
Poor home and living conditions	3	5	8
No opportunity, child	2	1	3
Child kept home to work	2	....	2
Moved frequently	4	4	8
Environmental:			
Entered school late (various reasons)	6	4	10
Sickness in family	....	1	1
Foreign born; parents, child; home language	2	5	7
Lived long distance from school	....	1	1
Poor, dangerous or mountain roads	1	1	2
No school available	....	3	3
Lack of school advantages	5	3	8
Irregular sessions	1	....	1
Inadequate instruction	9	4	13

[9] The percentage of children in this county who have become over age for their grade due to "irregular attendance" and "lax enforcement of truancy laws" is very striking. Evidently parents have not realized their full educational duty toward their children. Some of these children are as much as five years over age for their grade. Such retardation points to the need of further investigation in terms of parental stock and individual development, particularly in the field of mental ability. Truancy and irregular attendance in cases showing extremes of retardation are usually symptoms of lack of intelligence capacity rather than basic causes of such inefficient school conduct. Showing how certain types of conduct are prone to be attributes of interrelated or family groups, it is noted that most of the children referred to here as having irregular attendance are brothers and sisters. This emphasizes the importance of studying heritable characteristics which make for social inadequacy, failure, and unhappiness, and also studying environmental or economic factors which appear in connection with inefficient or inadequate conduct when found affecting interrelated or identical community groups.

Causes.	Boys.	Girls.	Total.
YAMHILL COUNTY—Continued.			
Miscellaneous:			
Cause undifferentiated	6	1	7
No cause assigned	5	4	9
Temperamental:			
Bad habits, bad conduct, lazy	2	....	2
Careless; indifferent; inattentive	1	....	1
Poor application, dreamer, other interests	3	....	3
Bashful, timid, self-conscious	3	2	5
Truancy	2	....	2
Physical:			
Undeveloped	4	2	6
Undernourished	5	3	8
Tuberculosis	....	1	1
Defective vision (eye disorders)	3	3	6
Defective hearing (ear disorders)	2	1	3
Defective teeth	1		1
Defective speech	....	2	2
Adenoids; tonsils; throat trouble	5	1	6
Crippled (various types)	5	1	6
Ill health, general	7	14	21
Mental:			
Mental dulling and mental defect	40	32	72
Affective deviation	3	....	3
Psychopathic states	3	....	3
Chorea, all forms	1	....	1
All other neuromental disorders	3	1	4
Total	163	116	279
Number of children mentallly and physically defective to such an extent as to be unable to acquire an education.—No information by county school superintendent. Percentage of over-age for grade pupils who showed signs of mental dulling or mental defect, 25.8.			
Heredity:			
Child has brother, sister, or other relative in school who is also over age for grade	43	41	84
Child has relative in the community with neuromental disorder	10	8	18
Child entitled to relief by crippled childrens' law	8	4	12
OREGON, ALL COUNTIES, GRAND TOTALS.			
[Per cent of school attendance to pupils of school age, whole state, 94 per cent. Approximate percentage of failures in classes, 10 per cent.][16]			
Parental:			
Heredity and constitutional inferiority	134	97	231
Loss of one or both parents (including divorce)	149	82	231
Indifference to child's welfare	56	42	98
Lack of home training	68	21	89
Child not kept in school	111	74	185
Irregular attendance	200	165	365
Economic:			
Poor home and living conditions	74	49	123
Parental poverty	15	5	20
No opportunity, child	73	74	147
Child kept home to work	71	32	103
Moved frequently	280	233	513
Environmental:			
Entered school late (various reasons)	264	262	526
Sickness in family	17	31	48
Foreign born; parents, child, home language	178	171	349
Lived long distance from school	43	60	103
Poor, dangerous, or mountain roads	23	20	43
No school available	41	30	71
Lack of school advantages	61	61	122
Irregular sessions	26	20	46
Inadequate instruction	98	54	152
Lax enforcement of truancy laws	20	10	30
Miscellaneous:			
Indian blood	11	12	23
Cause undifferentiated	97	61	158
No cause assigned	519	334	853
Temperamental:			
Bad habits, bad conduct, lazy	112	9	121
Careless, indifferent, inattentive	98	23	121
Poor application, dreamer, other interests	108	42	150
Bashful, timid, self-conscious	22	16	38
Truancy	63	31	94
Physical:			
Undeveloped	77	34	111
Undernourished	56	34	90
Too rapid growth	10	3	13

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[16] As reported by J. A. Churchill, State Superintendent of Public Instruction.

Causes.	Boys.	Girls.	Total.
OREGON, ALL COUNTIES, GRAND TOTALS—Continued.			
Physical—Continued.			
Tuberculosis	16	13	29
Defective vision (eye disorders)	133	89	222
Defective hearing (ear disorders)	74	35	109
Defective teeth	15	5	20
Defective speech	55	26	81
Adenoids, tonsils, throat trouble	142	83	225
Crippled (various types)	78	47	125
Ill health, general	450	470	920
Bad sex habits	8	9	17
Mental:			
Mental dulling and mental defect	1,407	849	2,256
Affective deviation	93	31	124
Psychopathic states	55	34	89
Chorea, all forms	10	6	16
Epilepsy	23	12	35
All other neuromental disorders	65	42	107
Total	5,799	3,943	9,742
62 boys and 40 girls feeble-minded, 15 boys and 8 girls blind, 41 boys and 34 girls deaf, 24 boys and 13 girls crippled, 3 boys and 1 girl had neuro-mental disorders, all to such an extent as to be unable to acquire an education and were so reported as the combined totals by the 23 county school superintendents who sent in definite information on such cases in accordance with law. County school superintendents, teachers and all school officials should use great diligence in making a full and accurate report of the mentally and physically handicapped children in each school and school district in order that proper returns may be transmitted by the county school superintendents to the state department of public instruction. The consolidated reports of the county school superintendents should present a constant survey of all social liabilities in persons of school age. This census should be made to include all persons from 1 to 21 years of age inclusive (the ages of developmental possibilities). Percentage of the 9,742 children, over age for grade, on whom reports were received, who showed signs of mental dulling or mental defect, 23.15.			
Heredity (exclusive of the 4,395 retarded school children in Multnomah County, it is seen that the remaining 5,347 out of a total of 9,742 retarded children showed the following facts relating to heredity):			
Child has brother, sister, or other relative in school who is also over age for grade	975	704	1,679
Child has relative in community with neuro-mental disorder	261	148	409
Child entitled to relief by crippled children's law	323	197	520

SUMMARY OF INSANE, MENTAL DEFECTIVES, DELINQUENTS, AND DEPENDENTS.

Individuals who are or recently have been in institutions.

Type.	State institutions, State funds.	Private institutions receiving public funds.	Total individuals.
Insane	3, 859	(1)	3, 859
Mental defective	656	(2)	656
Delinquent	1, 249	1, 585	2, 834
Dependent (exclusive of the dependent poor on poor farms)	540	1, 985	2, 525
Total individuals	6, 304	3, 570	9, 874

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[1] A small number of insane are known to be in private institutions, but as details are lacking they are not included. It should be made mandatory that all private institutions caring for the insane should make regular monthly reports of admissions, deaths, and discharges as well as an annual or biennial report to the central State board of control; and, further, that all such private institutions caring for the insane should operate only after being licensed for such operation and care of the insane by the central State board of control, which should have statutory powers to make all necessary and desirable "rules and regulations" governing these as well as all other types of homes, hospitals, institutions, clinics, dispensaries, or other agencies having to do with problems relating to public welfare.

[2] About 25 mental defectives are known to be in private institutions, but are included in this table under the head of "Dependents in private institutions" as they are juveniles. There are also other juveniles and young adults in various private institutions, wholly or partially dependent upon public funds, who are believed to be mentally defective. It would be a wise public policy if all institutions caring for dependents made special provision for those of defective mentality and, where practicable, transfer them to the State institution, in order that all matters relating to the problem of their care, treatment, and training be centralized and the cost of maintaining such mentally defective dependents reduced.

Individuals who are, or recently have been, social liabilities either in communities or in institutions in Oregon.

Type.	Number in the communities, including poor farms.	Number in all types of public or private institutions.	Total individuals.
Insane	135	3,859	3,994
Mental defectives (including 60 neuro-mental cases)	1,077	656	1,733
Delinquents	27,307	2,834	30,141
Dependent (including 54 blind, 156 deaf, 126 crippled, and 43 tubercular cases)	27,030	2,525	29,555
Total individuals	55,549	9,874	65,423

There are, in addition to the above, a few hundred more individuals who were complete or partial dependents on public funds or private philanthropy, cared for in general hospitals on account of some form of physical disease, defect or disorder, but concerning whom no detailed reports were available. It should be made mandatory that all institutions, including general hospitals, caring for dependants of any type, irrespective of whether they are supported by public or private funds, should publish an annual or biennial report showing the number and type of such complete or partial dependents cared for, and submit the same to the State central board of control dealing with all matters relating to public welfare, for the information of the citizens of the State.

Research by the United States Public Health Service and other organizations interested in public welfare shows that approximately six persons in every thousand in the general population of the United States suffer from some form of mental defect, disease or disorder. Furthermore, these investigations have shown that 0.3 per cent to 1.3 per cent of the children attending school in the various localities investigated throughout the United States are feeble-minded, and that there are still others in whom the mental defect is in the volitional and emotional field rather than in the intellectual. These latter are potentially more antisocial in their conduct in later life than the purely feeble-minded.

The Oregon State survey has recorded the facts relating to mental and physical defect, disease or disorder, delinquency and dependency as found in the community and in institutions. The community and institutional tables present, for your consideration, the record of a certain number of persons who, by reason of mental or physical symptoms, have shown odd, subnormal, delinquent, or inefficient conduct and so have written themselves upon the public records of Oregon as actual social liabilities.

The Oregon State survey also made a review through the cooperative teacher's referendum of 9,742 school children who were over age for their school grade and therefore retarded in their school progress. These 9,742 over age for grade pupils represent a school enrollment of approximately 32,480 pupils. The total number of children in Oregon of school age is: Boys, 124,897; girls, 96,404; total, 221,301. The number of children actually attending school during the last official year was: boys, 72,765; girls, 74,647; total, 147,412.

The cooperative teacher's referendum conducted by the Oregon State survey is therefore the composite opinion of dozens of qualified school-teachers having under their charge 32,480 pupils, or 22 per cent of all the school children in the State of Oregon.

The reason for making this analysis of why school children become over age for their school grades in connection with the other work of the Oregon State survey is because in the school population you have, all in one group, practically the whole population of adults for the next generation. In school life and school progress are first to be detected symptoms of inadequate, inefficient, unsuccessful conduct which, if not recognized and adequately corrected during adolescence, inevitably tend to develop into more or less fixed habits of thought and behavior which will render the individual incapable of attaining the fullest possible measure of success as an individual and as a constructive citizen.

The retarded pupil in school is over age for his grade because of some specific cause which acts as a handicap to expected progress. It is the duty of the State, county, city, village, and rural school authorities, including all teachers, to ascertain this cause for pupil retardation in each and every instance. School officials, parents, teachers, and the public generally must unite to study and eradicate all obstacles to pupil efficiency in attaining grades. This is constructive help of the highest practical value. In definitely safe-guarding the health, happiness, and success of your children, you are insuring the erection and preservation of high ideals of citizenship; upon all of which rests the ultimate welfare of the state.

It is well to pause therefore and carefully consider the ultimate basic meaning behind each one of the causes assigned by the teachers as a cause of pupil retardation. Mental dulling, mental defect, mental disease, and mental disorder are the basic causes for social inadequacy, economic failure, delinquency, and dependency in the majority of cases. The teachers' referendum shows they believe that 23.15 per cent of all the children who become retarded in school do so by reason of mental dulling or mental defect. This does not mean that they are all incapable of getting along in community life. It does mean that nearly one-fourth of all children over age for their school grades have given evidence of a very definite form of handicap which should in every instance be accurately diagnosed and such steps taken, through special scholastic or vocational training, as will enable that particular child to reach the uttermost heights of his developmental capacity.

The low-grade mental defective will be found to do best and develop further in adequately equipped State institutions where great stress is laid on specially adapted forms of manual training in connection with other forms of modern care and treatment. These low-grade mental defective types will require permanent segregation. This will be carried out best and with most economy to the taxpayers, by means of farm colonies with inexpensive types of buildings. In Oregon there is a great field open to reforestation activities by these mentally defective wards of the State.

Higher grade mental defectives capable of greater mental advancement than the first type and hence not suited to the ordinary State institution for mental defectives should be provided with a special State boarding school where all phases of this special institution's efforts in care, treatment, and training should be directed toward fitting these handicapped children to go out eventually into community life, but only under a system of permanent State supervision.

The next higher group of mental defectives found in your public schools should be educated through the medium of special classes in the public school system. They also will need constant parental and later county and State supervision in the various communities where they will reside, both as juveniles, adolescents, and adults. Then after this is done, let us remark in passing, the children in school who are not handicapped by any form of mental defect will be able to advance much faster, being no longer limited in progress to the rate of the handicapped who under the present-day system are now in the same room or class with them. Hand in hand with all of this plan goes the elimination of all other forms of handicap, i. e., physical, environmental, economic, and parental, so far as it is in the power of an enlightened community awake to the possibilities for assisting their children to success to achieve this result. Let there be accurate detection of all causes of retardation, discrimination as to basic types, diagnosis of mental or physical defect, disease, or disorder and elimination of unnecessary environmental and economic obstacles.

Every child has a right to ask the State to see that he or she is given the chance to develop, to be educated, and to be trained up to the very limit of his mental or physical capacity. If the parents or the community are indifferent, it is the high privilege of the State to see that the welfare of the children is not neglected. In this connection there were found 323 boys and 197 girls, a total of 520 children among the 9,742 retarded pupils who appeared to need medical or surgical attention to overcome some particular handicap to successful school work and were therefore entitled to relief under the crippled childrens' law of Oregon.

COMPARATIVE FIGURES.

The world prior to the war was beginning to realize the fact that mental defect, mental disease, and mental disorder played a very definite and specific rôle in producing subnormal and inefficient conduct. The clinching of this knowledge took place upon the anvil of war's necessity where those unfit for military service were rejected. Those rejected on account of mental defect were unable to carry out orders; they were inefficient in their conduct; they were useless for the defense of the Nation; they were permanent social liabilities. They were turned back into civil life and now and for all time will be a community burden, a source of weakness and a cause of increase in taxation due to the necessity of maintaining hospitals, institutions, courts, jails, or poor farms to eventually receive them as time goes on, for they will inevitably demonstrate their inefficiency as constructive social units.

The Oregon State survey has been conducted with the view to demonstrating the particular needs of this State, taking into consideration the factors of geographical situation, terrain, climate, industry, and ethnological problems. The survey is a presentation of the facts of community life in Oregon collected and recorded by its own citizens and offered to the citizens and the representatives of the citizens in the legislature of the State as a means of assisting the people and the legislators to correct any defects found in the community structure. Oregon is to be congratulated in many respects, but in one particular it shines so resplendent that no survey of community and citizen life in the State would be complete without mention of it. The facts are these. In the records of the operation of the selective-service act (Defects found in Drafted Men, prepared under the direction of Surg. Gen. M. W. Ireland, Medical Corps, United States Army, by Maj. A. G. Love, Medical Corps, United States Army, and Maj. Charles B. Davenport, Medical Corps, United States Army, and also the official reports of the Provost Marshal General, United States Army), all forms of mental and physical defect, disease, and disorder are recorded which caused the rejection of the men selected for service. State after State is shown with both the actual number and the ratios of men examined for each State and for the whole United States. The following excerpts from the official records give the facts relating to neuro-mental disorders in the State of Oregon:

Type of neuromental disorder.	Oregon (ratio per 1,000).	United States (ratio per 1,000).
Epilepsy	3.94	5.15
Chorea	.12	.22
Neurosis	.06	.12
Mental deficiency	8.06	12.06
Total constitutional psychopathic states, mental deficiency, dementia præcox, psychasthenia, psychoneuroses manic-depressive psychoses and other psychoses (insanity)	11.26	15.08

Percentage for cause of rejection by local boards and camp surgeons and for discharges from the Army of recently inducted men: Mental deficiency, Oregon, 2.7; for the whole United States, 5.2 per cent.

Stepping out of the column of figures comes the long swinging column of fours "in olive drab"—the army of the men of Oregon. With their splendid record of unusual mental fitness backing up their endeavors, they gave the world a demonstration of what the efficient, constructive citizen means in terms of patriotism, for Oregon topped all the States in the Union in its ratio of enlistment credits to its gross draft quota, this ratio being 90.11, while that for the whole United States was 40.42. Oregon was just a little better than twice as ready to fight for Old Glory as the average.

With such a background, with such initial endowment, with such fighting spirit, Oregon now stands in a position to step 50 years ahead of the rest of the world in the matter of the systematization and administration of all her problems in the whole field of public welfare by taking advantage of the experience of several States which have adopted new plans and passed enactments relating to improvements in administrative policy in all matters relating to public welfare.

Oregon is now able to step out of the outworn methods of the past by adopting a modern system of institutional and community care, clinical treatment, and administrative procedure which will be a model in public welfare work for the whole world.

The Oregon State survey, knowing the great possibilities open to this State in the field of public welfare, presents for the consideration of its citizens a tentative plan for enlarging the scope of the central State board which now has control of the affairs of Oregon relating to public welfare. This plan should be worked out by utilizing all those measures of proven worth which are to be found in the various plans of the several States which have made the most advance in matters relating to the detection, care, treatment, and training of the handicapped.

Avoidance of useless repetition of effort, the concentration of official energy on specific problems, better types of care, treatment and training for the handicapped, and a per capita cost commensurate with real results, are the foundation stones of all these efforts to modernize our system of State care and to attain an advanced place in public welfare. A few details of the proposed plan for systematizing the work of the State will be found under "Suggestions for desirable legislation" of the Oregon State survey.

The need of such a step forward is seen if the State is to be able to formulate its future program for public welfare with that intelligence which is based on an intimate knowledge of the facts, this in turn making for the economical administration of the public funds. The ratio and percentage of mental defect, disease, and disorders in Oregon at the present time, based on the 1920 census, general population 783,285, are as follows:

Insane, in community and in State hospitals for the insane, 3,984. This is a ratio of 5 per thousand of the general population, or one-half of 1 per cent.

Mental defect (three groups): (*a*) In communities and special institutions; (*b*) mental defect as found in delinquents; (*c*) mental defect as found in dependents.

(*a*) Mental defect in communities and special institutions, 1,733.

(*b*) Mental defect as found in delinquents: There were 30,141 delinquents in the communities and penal institutions of the State at the time of the State survey. Excluding 20,000 (approximately two-thirds) as traffic ordinance violators and petty offenders, there is a remainder of 10,141. A conservative estimate based on intensive studies shows that not less than 10 per cent of all apprehended delinquents show definite mental defect, mental disease, or mental disorder. Ten per cent of 10,141 is 1,014.

(*c*) Mental defect as found in dependents: There were 29,555 complete or partial dependents in the communities and various institutions of the State at the time of the State survey. Excluding 20,000 (approximately two-thirds) as being dependents due to temporary or remedial physical, economic, or industrial causes, there is a remainder of 9,555. A conservative estimate based on intensive studies shows that not less than 10 per cent of all actual dependents (the inefficient "poor") show definite mental defect, mental disease, or mental disorder. Ten per cent of 9,555 is 955.

Total cases of easily ascertainable mental defect in the State, 3,702. This is a ratio of 4.7 per thousand of the general population, or forty-seven one-hundredths of 1 per cent. The combined total of all the known insane and all the known mental defectives, with the approximate number of mental defectives among all delinquents and all dependents, is 7,686. This is a ratio of 9.8 per thousand of the general population, or ninety-eight one-hundredths of 1 per cent.

There was found by the survey a total of 65,423 individuals who were either potential or actual social liabilities. If we exclude one-half of the delinquents as unimportant petty offenders, and, further, exclude one-half of the dependents as being probably remedial cases, we have a total of 45,574 persons. These 45,574 individuals are the ones who caused practically all of your tax expenditures in maintaining police, constables, sheriffs, courts of criminal jurisdiction, jurors, witnesses, jails, reform schools, penitentiaries, and all State, county, and city institutions, homes, hospitals, free dispensaries, clinics, and other agencies engaged in caring for, treating, or otherwise assisting the mentally and physically handicapped, the delinquent, and dependent. These 45,574 individuals represent 5.8 per cent of the general population. Excluding the known cases of insanity and the known cases of gross mental defect now in the communities and in special hospitals or institutions, and excluding further one-half of the delinquents as petty offenders and one-half of all the dependents as being probably remedial cases, we find there is a total of 29,847 individuals in the State who as actual delinquents and dependents have shown themselves, by their subnormal, inefficient, nonconstructive conduct to be actual social liabilities—a constant drain upon the public purse; a constant menace to the orderly and successful progress of the State. These 29,847 delinquent and dependent individuals represent 3.8 per cent of the total population.

Exclusive, therefore, of all remedial cases of social inadequacy, we find that the great bulk of all public expenditures for the relief, care, treatment, and training of the misfits of the State is caused by approximately 4 per cent of its inhabitants.

THE REMEDY.

As fast as any of these inadequate social types appear upon your public records, whether in court, hospital, institution, prison, or poor farm, let an accurate mental, physical, and economic diagnosis be made and the case legally disposed of upon the basis of what the actual fundamental causes of the delinquency or dependency may be.

Segregate the unfit. Treat the sick. Rehabilitate the handicapped. Educate and train the neglected and ignorant. Protect the 96 per cent of normal citizens from the inadequacy of the subnormal 4 per cent by adequate statutes which are enforced. Systematize and broaden the State's administration of all problems relating to public welfare. Let the home, the school, the store, the shop, the farm, the town, the city, the State unite in a great campaign of eliminating the cause of sorrow, sickness, inadequacy, delinquency, and dependency.

SUGGESTIONS FOR DESIRABLE LEGISLATION.

The following suggestions for desirable legislation are based on information received from citizens of Oregon and upon researches made by the survey into legislative needs and former enactments in this and other States.

EDUCATION AND SCHOOLS.

As the result of the teachers' referendum as to why pupils become retarded in school work and over-age for their school grades it is suggested:

1. In order that the State superintendent of public instruction may be able to inform the people of the State as to exactly how many over-age for grade retarded pupils there are in all the schools of the State at the close of each official year, it is suggested that all teachers' reports to local principals or to the county school superintendent, if sent to him directly, as is the case in rural schools, and all the principals' reports to the local city school superintendent, or if none, to the county school superintendent, and all city school superintendents' reports to the county superintendent of schools should show the number of children and the age of such children in each school grade for each class, room, or school so reporting; and, further, that such reports should be so arranged as to show the number of children, with their ages, who are over age for their grades according to the annexed schedule, which should be known as the schedule for "at-age-grade recording" and indicates the rate for satisfactory, expected progress in school.

All children who are older than the schedule indicates they should be for the grade in which they now are, should be recorded on the teacher's report as over-age-grade children with the cause thereof stated in each instance for each such child. This report should be forwarded in the usual manner and through the usual channels for consolidation in the annual report of the county school superintendent and forwarded by him to the State superintendent of public instruction. The State will thereby be enabled to keep a constant record of retarded, over-age for grade school children, the incidence of such retardation, with the cause thereof, and can thereupon take such steps as may be necessary to correct the causes for such retardation and relieve the handicapped child.

The following chart should be known as the satisfactory "at-age-grade chart." It expresses normal, expected progress in school grades. It is the expected age-for-grade schedule. A pupil, to be at expected age grade should be in—

Grade 1 when 6 to 7 years old.
Grade 2 when 7 to 8 years old.
Grade 3 when 8 to 9 years old.

Grade 4 when 9 to 10 years old.
Grade 5 when 10 to 11 years old.
Grade 6 when 11 to 12 years old.
Grade 7 when 12 to 13 years old.
Grade 8 when 13 to 14 years old.

2. It is suggested that all school teachers of public, private, or parochial schools, all school principals, all city school superintendents, all county school superintendents, and all district school clerks should collect all information relating to children between the ages of 1 year and 21 years who by reason of being totally or partially blind or deaf, or by reason of having disorders of speech, or who are epileptic, or who are crippled, or who are mentally defective to such an extent as to be unable to acquire an education in the local schools and who therefore require special instruction. They should report such facts annually, together with the name of the child, the sex, age, type of mental or physical handicap, and legal residence to the county school superintendent. Further, every such child known to be suffering from any form of mental or physical defect, disease, or disorder, whose parents, after notification by the local school authorities, make no effort to alleviate such mental or physical handicap, should be reported in the annual report of the school in the district of which said delinquent parents reside, to the county superintendent as being a child entitled to relief under the "crippled children's law" of Oregon, and the county school superintendent should thereupon report such facts relative to such crippled and handicapped child to the county judge, who should take such steps as he deems necessary to insure to the handicapped child adequate relief, care, treatment, and training.

3. Recognizing the eminent right of every child of this State to receive the benefits of education, statutory provision should be made to insure such benefits to every child, regardless of local conditions by—

(*a*) Strict enforcement of existing truancy laws in every section of the State; guaranteed by a system of school inspection by the State department of education.

(*b*) Abolishing the distance limits of residence beyond which a child may not be made to attend school. Such limits make it impossible to enforce the truancy laws in certain localities.

(*c*) Enforcing the provision in the school laws in all localities for the transportation of pupils who live at a great distance from school.

(*d*) Creating union school districts as rapidly as possible; such districts to be consolidated with the view to having the school in the center of the district or in such place as may be most easily reached by the children and most practicable for the transportation of the children, particularly in inclement weather.

(*e*) Assisting children handicapped by blindness, deafness, speech or other mental or physical defect or disorder to become happy, efficient and self-supporting citizens. To this end it is suggested that no blind or deaf child, or child with speech disorder, or an epileptic, or a child who is crippled, or a child otherwise mentally or physically handicapped, should be allowed to grow up in this State without an adequate education, scholastic and vocational, suited to his or her mental and physical developmental capacity; and that such child, when not otherwise relieved or cared for, should receive the benefits of such special education at the special schools maintained by the State for the education, care, treatment and training of the blind, deaf, crippled, or otherwise mentally or physically handicapped; and, further, it is suggested that any such child who is only partially blind, deaf, suffering from speech disorder, or otherwise crippled or mentally or physically handicapped so as to be unable to advance properly in the local public, private, or parochial schools, should be considered as entitled to relief under this act; and, further, that the enforcement of this act should devolve upon the local school authorities of the school district of which the handicapped child is a resident or in which he may be, in each case; but the State board of health, the State board of control, the State superintendent of public instruction, or the child welfare commission may, upon its own motion, apply for such relief for any such child.

(*f*) Believing the early detection of mental or physical defect, disease, or disorder is one of the fundamental necessities in eradicating many causes of pupil retardation in school, failure in later life, inefficiency in industry, and inadequate conduct in community life generally, it is suggested that statutory enactments be made which will encourage and develop a thorough system of regular medical inspection of all schools and all school children by competent and duly licensed medical practitioners; and further that all counties, in order to improve the hygiene of school life and the health of the indivadual school children, should employ one or more county health nurses and one or more county school nurses who should work under the direction of and in conjunction with the medical inspectors of the city, village, and rural schools, the city, county, and State health officers, and all the local county health associations, including the local chapter or branch of the American Red Cross.

(*g*) Believing that the presence of mentally defective pupils in the regular classes in the public schools is detrimental to the proper training of such mental defective children, and, further, that their presence is a great hindrence to the proper instruction and possibilities of advancement of the normal pupils in the same class where such mental defectives may be, it is suggested that in all schools where a retarded pupil is three or more years over-age for his grade, according to the schedule for expected school progress annexed to these suggestions, that such child, three or more years over age for grade, should be examined by a physician who is a trained psychiatrist, or a psychologist, or by both if deemed desirable, upon the petition of the teacher or the principal of the school of which such child is an enrolled pupil, or upon the petition of the city or county superintendent of schools of the city or county of which the child is a legal resident or wherein he may be; and if such child is found to show actual mental defect, he or she should be transferred to a special class for the education and training of such mentally defective children. Further, that as this measure is designed to afford the handicapped child the best chance for overcoming his or her handicap, the school-teacher and school officials having charge of the education of such handicapped child should take every means to see that such handicapped child is given adequate relief by proper and suitable scholastic and vocational training in a school, institution, or special State school adapted to his or her specific needs. That such relief may be afforded such handicapped children it is suggested that every city or village and rural school having five or more such handicapped children three or more years retarded and over-age for their school grades, and who after the special mental examination hereinbefore mentioned are found to show definite symptoms of mental defect, mental disease, or mental disorder should establish special classes for the scholastic education and vocational training of such mentally defective children whereby such handicapped children may be receive instruction to the limit of their developmental capacity.

Further, it is suggested when any child attending any school in this State shall show evidence of mental defect, by reason of failure to advance in classes, or by odd or unusual conduct detrimental to the health or morals of the other children in the school, or who, after a mental and physical examination by the school physician, or a special examination by a competent psychiatrist or psychologist, shall be found to show mental defect, mental disease or mental disorder, the teacher or principal in charge of such child should report the facts to the county or city school superintendent according to whether the school is in a rural or city school district. The city superintendent should in all cases report such facts to the county school superintendent and they, together, or the county school superintendent alone, should, if the condition of the child renders him or her unfitted to continue as a pupil in the local school, arrange for his or her care, treatment, scholastic education, and vocational training at the State institution for mental defectives, and should make the usual petition to the judge of the county court for the commitment of such mentally defective child to such State institution, upon the usual legal forms made and provided. The purpose of this suggestion is to provide a better opportunity for such mentally handicapped children in a specialized State school than can be found for such children in the local public schools, which lack the special facilities necessary for such care, treatment, and training.

(*h*) The establishment of local school and community health clinics, which teach the elementary rules of health to both children and to adults, and provide a means for early diagnosis of mental and physical defect, disease, and disorder, is for the best interests of the public welfare. They are hereby indorsed and their further establishment encouraged. The consolidation, cooperation, and coordination of all county, city, and community health work with such health clinics is earnestly advocated.

(*i*) It is suggested that the type, character, and curriculum of all scholastic training, all special industrial training and all vocational training used for the mentally or physically handicapped, either children or adults in any State, county, or municipal hospital, institution, school, clinic, dispensary, or other agency, the inmates of which are dependent, either wholly or in part, upon public funds, or in any private hospital, institution, or school receiving public funds, or in any private hospital, institution, or school which does not receive public funds, but which cares for inmates who show some form of mental defect, disease, or disorder, or who are delinquent, whether under sentence or commitment, or not, or who are wholly or partially dependent upon the funds of relatives or others for their support, should conform in all respects to all minimum requirements as to course of study, hours of school work, and all other matters related to the education and training of children or adults, laid down and determined by the State department of public instruction; and further, that the officers or inspectors of the State department of public instruction should, at all times, have the statutory right to visit and inspect all such hospitals, institutions, schools, or other agencies caring for, training, or teaching such mental or physical defectives, delinquents and dependents. Failure to comply with the provisions of this act should entail the supension of all payment of public funds and the withdrawal of the license to care for inmates of any type, whether supported by public or private funds.

(*j*) Knowing that a foreign language when spoken exclusively in the home of a school pupil is one of the major causes for that pupils' becoming overage for his school grade and retarded in school work, it is suggested that the Americanization of all such foreign language speaking parents be made a part of the educational program of the State department of public instruction, the University of Oregon, the Oregon Agricultural College, all other institutions for higher education, normal schools, and all city, village, and rural schools in the State of Oregon.

SUGGESTIONS CONCERNING DELINQUENTS.

Realizing that delinquency, including juvenile delinquency, is often the result of mental defect, mental disease, or mental disorder, it is suggested that all municipal, district, justices' county, and circuit courts, and all other courts having jurisdiction over juvenile offenders should have a competent and duly licensed physician, together with a competent psychiatrist, or psychologist, make jointly a complete mental and physical examination of all such juvenile delinquents and report the result of such examination to the court having jurisdiction over such delinquents, which should consider the findings of such examination before its sentence is pronounced on such delinquents; and if such delinquent is found to be suffering from any form of mental defect, mental disease, or mental disorder, the court should, upon the evidence before and the results of the aforesaid joint mental examination, commit such mentally defective delinquent to such State institution as may be most appropriately equipped to care for such defective delinquent, with the idea in view of affording such defective delinquent such adequate care, treatment, and training as will best assist in his or her mental and physical betterment and social rehabilitation.

Recognizing that the juvenile delinquent is, in the majority of instances, a neglected or dependent child, it is suggested that every county should provide at least one place of detention for such juvenile delinquents, entirely separate and distinct as to building and personnel from all buildings and personnel used for the detention of adult delinquents; and, further, that all such juvenile delinquents should be kept in such special place of detention, immediately after apprehension, or while awaiting trial, or during adjournment of court, or after sentence, or commitment, while awaiting transfer to the institution to which he or she has been sentenced or committed. In such detention homes for juvenile delinquents the sexes should be kept separate at all times, and, further, none but women should be in charge of girls or women at any time, including transportation to and from court and all institutions.

SUGGESTIONS CONCERNING DEPENDENTS.

Realizing that dependency, either partial or complete, is often the result of mental defect, mental disease, or mental disorder, it is suggested that in each county, when a dependent person shall seek relief by applying for or accepting money, food, clothing, shelter, or medical care to be paid for from public funds, the county judge should, before such relief is permanently afforded, cause such dependent to be thoroughly examined by a competent and duly licensed physician, psychiatrist, or psychologist, and if such dependent is found to be suffering from any form of mental defect, mental disease, or mental disorder, the county judge should cause such dependent to be committed to such State institution as may be most appropriately equipped to care for such defective dependent, with the idea in view of affording such defective dependent such adequate care, treatment, and training as will best assist in his or her rehabilitation as a useful, efficient, and constructive citizen; and, further, that the name, sex, age, legal residence, and type of relief afforded should be made a part of the public record relating to such dependent, including a record of all costs thereof and all expenses paid out from the public funds on account of such dependent, including the pro rata cost of handling his case for judges' salary, court expenses, transportation, food, lodging, heat, light, or clothing, and all other expenditures, which should be itemized in order that the exact cost of each such dependent may be known to the citizens; and, further, all such facts relating to all such dependents and the cost thereof to the citizens should be published in the annual or biennial reports of all counties in the State of Oregon.

Realizing that there are at all times many individuals wholly or partially dependent upon public funds in this State who are nonresidents, or aliens, it is suggested that the central State board of control be empowered to cause the return of such nonresident dependents to the State of which they are residents, or to cause the deportation of such alien dependents to the country of which they are legal residents; and, further, that the central State board of control be empowered to carry the provisions of this act into effect, and in doing so may expend so much of the public moneys appropriated for the care of the mentally defective, or of the insane, or of delinquents, or of dependents, as may be necessary.

Any person who shall knowingly bring, entice, or assist in bringing any nonresident, or alien, into the State, who is known to be, or to have been, a mentally defective-delinquent, or who is known to be wholly or partially dependent by reason of any mental or physical defect, disease, or disorder, should be guilty of misdemeanor, punishable by fine of $1,000 or by imprisonment for one year, or both.

All officials in each city and county, including the supervisor of the county poor farm, caring for dependents, whether such dependency is caused by mental or physical defect, disease, or disorder, or otherwise, should keep an accurate record of each dependent person assisted by public funds in said county. Such records should show the name, sex, age, occupation, including actual legal residence, county, State, and country; whether such dependent is a complete dependent or a partial dependent; whether such dependent was maintained in a city, county, or State home, hospital, poor farm, or institution, with the dates of admission and discharge, or date of death; whether such dependent has been maintained as a complete or partial dependent in the community as a "boarded out poor person"; or had, as a complete, or partial dependent, received public funds and been maintained in his own home, or the home of friends or relatives. Such records should include the cost of all items of medical care, food, heat, light, shelter, or clothing, and transportation, if any; and further, that all orders, vouchers, or other documents upon which public funds are expended from the State, county, or city treasury, should state the name, age, sex, occupation, and legal residence and cause of such dependency of each dependent person completely or partially maintained by such State, county, or city funds.

Realizing that dependency is frequently due to mental or physical defect, disease, or disorder, and that permanent poor relief without adequate knowledge of the dependent person's mental and physical condition entails an aimless expenditure of public funds, the keeping of accurate records in each county as to the name, age, sex, occupation, legal residence, degree of dependency, type of dependency, and total expenditure for each complete, or partial dependent should be declared to be necessary to the public welfare; and the provisions of this act should be strictly enforced. All such itemized reports relating to either delinquents or dependents, or to delinquent dependents, should be returnable annually to the State, county, and city treasurers; and their reports thereon transmitted to the State board of control for final consolidation and publication for the information of the citizens of the State.

All legal warrants or orders for commitment of delinquents or dependents, and all vouchers, bills and other legal evidences for the expenditure of public funds from the State, county, or city treasuries, for delinquents or dependents, either complete or partial; and whether maintained in State, county, or city institutions, homes, hospitals, or other agencies, including the county poor farm, or elsewhere should be made out only on blank forms, arranged and approved by the central State board of control, which should have statutory power to make all necessary "rules and regulations" governing the maintenance, care, treatment, and training of all delinquents and all dependents, complete or partial, resident, nonresident, or alien, cared for either by public, philanthropic, or private funds within the State, and should have general supervision over such delinquents or dependents in communities, after they have been discharged from State, county, or city institutions, homes, hospitals, clinics, or other agencies.

Realizing the difficulty which exists at the present time of ascertaining the actual number and the actual total cost to the public funds of mental defectives, insane, epileptics, blind, deaf, and crippled individuals passing through the county courts and all other courts and finally reaching the various State institutions; and also the number of male and female, juvenile and adult delinquents; and also male and female, juvenile and adult, complete or partial dependents; it should be enacted that the central State board of control make a special study of the size, number, type and form of all blank orders, legal records, commitments, vouchers, and books which should be adopted and used in all State offices and institutions and in all counties, cities, and incorporated towns and in all rural districts for use in recording all facts relating to matters of public welfare as follows: Identical blank forms for recording the arrest, apprehension, appearance before court, sentence, commitment, or other disposition of all individuals appearing on our public records as delinquents, or dependents, with the costs thereof, including all costs for the arrest, apprehension, appearance before a court, sentence, commitment, other disposition, and all traveling and transportation expenses, and all expenses for food, medical care, clothing, heat, light, shelter, and all incidental and contingent expenses of whatever nature, including the calling of witnesses, jurors, and all other items which are a charge upon the public funds of the State, county, or city in which the individual suffering from some form of mental or physical defect, disease, or disorder which necessitated care, treatment, or training by public funds, or who was delinquent or who was a complete or partial dependent, was found.

The purpose of such systematization of State, county, city, and rural bookkeeping, under the direction and supervision of the central State board of control, should be:

(1) To ascertain the exact number of insane and mental defectives and epileptic and blind and deaf and crippled individuals appearing on all city and county records each year, and the individual cost thereof.

(2) To ascertain the exact number of delinquents, male and female, juvenile and adult, and type of offense, appearing on city and county records each year, and the individual cost thereof.

(3) To ascertain the exact number of dependents, male and female, complete or partial, and cause of dependency, appearing on the city and county records each year, and the individual cost thereof.

(4) The actual total cost to the city and to the county and rural districts of each type of mental or physical defect or delinquency or dependency, and the grand total of such individual cases and the absolute total cost thereof to the public funds of any one county and all rural districts, towns, and cities therein.

(5) The city records should be consolidated with the county records, item by item; all individuals kept as separate items; all costs

of each individual kept separately and credited to one particular individual and a consolidated record made in this manner.

(6) The consolidated city, rural, and county records should be turned into the central State board of control, where they should, by counties, indicate the number of individuals and the costs of such individuals, and the type of mental or physical defect, disease, disorder, delinquency, or dependency which such individuals showed; and such records, when so compiled, should be a complete record of mental or physical defect, disease, or disorder, delinquency, and dependency, covering the whole State, which should show the combined total of (*a*) defective, delinquent, and dependent individuals cared for, sentenced, or relieved by public funds; (*b*) the type of mental or physical defect, disease, or disorder for which the care, sentence, or relief was had; (*c*) the total and combined cost of such individuals to the city, county, and State. (At the present time it is impossible to ascertain these facts without undue research through city, county, and State records and there is no consolidated record covering the whole State.—Note by director of the survey.)

The magnificent response of the University of Oregon to the call of the legislature to conduct the Oregon State survey which was to demonstrate the causes of physical ill health, mental defect, and social inadequacy has clearly vindicated the motto of the university: Mens agitat molem (mind moves matter), and has further illustrated the fact that the university is able to serve the people of Oregon in many ways through the extension division, whose motto is: The State is the campus. It has occurred to the director that if the citizens so desire, the university could be of assistance to the various State agencies whose functions relate to public health and public welfare by the utilization of its various departments as a bureau of research and analysis to be conducted in cooperation with and under the direction of the State agency of public health for the benefit of the whole people.

APPENDIX.

STATE OF OREGON.

[SEAL] of the University of Oregon.

HEADQUARTERS OF THE OREGON STATE SURVEY OF MENTAL DEFECT, DELINQUENCY, AND DEPENDENCY.

[1] Reposing special confidence in the discernment, integrity, and patriotism of Benjamin Franklin, he is hereby requested to act as special voluntary assistant to the State survey of mental defect, delinquency, and dependency, serving without remuneration from a sense of high citizenship and patriotism in accordance with senate joint resolution No. 28:

Be it Resolved by the Senate of the State of Oregon (*the House of Representatives jointly concurring*): Whereas there is in Oregon, as in every other State, a large number of dependent, defective, and delinquent people of whom only a small percentage of the most extreme types are cared for in institutions; and

Whereas the experience of draft boards has shown the members of these groups who are at large to be not only a source of weakness but a positive liability to the State and Nation on account of their incapacity to fight and limited ability for work; and

Whereas the experience of relief agencies, juvenile courts, poor farms, jails, and all other agencies caring for dependents, defectives, and delinquents shows that, whether in institutions or at large, these classes are a constantly increasing drain on the finances, health, morals, and every other resource of the State, and when improperly cared for contribute to social and political unrest; and

Whereas it is the duty of the State to be just and merciful to its unfortunates and at the same time to promote the best interests of the State as a whole by preventing, as far as possible, the increase in numbers of dependents, defectives, and delinquents; and

Whereas the University of Oregon has indicated its willingness to serve the State by making a survey of dependency, defectiveness, and delinquency, including public and private institutions and agencies dealing with such classes, in order to determine the extent and causes of said dependency, defectiveness, and delinquency, and to suggest ways and means for reducing the State's burden from these sources: Therefore, be it

Resolved, That the University of Oregon is hereby granted authority to make such survey, and is requested to report the result of its study, with recommended legislation, to the next regular legislative assembly, with the understanding that the university will conduct this study according to its own plan, and that the State will be asked for no appropriations for this purpose.

Filed in the office of the secretary of State February 27, 1919.

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[1] Wording of the certificate or "Commission" issued by the Oregon State survey to over 10,000 volunteer assistants.

As special voluntary assistant to the State survey of mental defect, delinquency, and dependency, you are requested to write to the headquarters of the State survey, extension division of the University of Oregon, Eugene, Oreg., for instructions and statistical data cards for recording cases of mental defect, delinquency, and dependency which come under your personal observation, such cards to be returned to the headquarters of the survey when completed. Headquarters for Multnomah County, room 652, Courthouse, Portland; headquarters for all other counties of the State, extension division, University of Oregon, Eugene, Oreg.

Issued at the headquarters of the State survey of mental defect, delinquency, and dependency, Extension Division, University of Oregon, Eugene, Oreg., this 15th day of April, 1920.

CHESTER L. CARLISLE, M. D.,
United States Public Health Service,
Director Oregon State Survey of Mental Defect,
Delinquency, and Dependency.

[SEAL] of the
University of
Oregon.

RELATED PUBLICATIONS.

Available reprints and bulletins on mental deficiency, issued by the Public Health Service, from which copies may be obtained without cost:

PUBLIC HEALTH BULLETINS.

77. Rural school sanitation, including the physical and mental status of school children of Porter County, Ind. By Taliaferro Clark, G. L. Collins, and W. L. Treadway. 1916. 16 pages.
90. Mentality of the arriving immigrant. By E. H. Mullan. 1917. 131 pages.

REPRINTS FROM THE PUBLIC HEALTH REPORTS.

236. Mental deficiency. With special reference to diagnosis. By E. H. Mullan. November 27, 1914. 8 pages.
377. Mental status of rural school children. Sanitary survey in New Castle County, Del.; with a description of the tests. By E. H. Mullan. November 17, 1916. 14 pages.
The mental status of rural school children of Porter County, Ind. By Taliaferro Clark and W. L. Treadway. (Reprinted from Public Health Bulletin No. 77. 1916. 16 pages.
467. Some observations on the personality of feeble-minded children in the general population. By Walter L. Treadway. May 17, 1918. 11 pages.
514. Some observations on mental defectiveness and mental retardation among children. By Walter L. Treadway. April 11, 1919. 5 pages.

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 113
MAY, 1921

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BASED UPON A SURVEY OF HEALTH ACTIVITIES
AND SANITARY CONDITIONS IN MAY, 1920, AND

RECOMMENDATIONS FOR REORGANIZATION OF HEALTH DEPARTMENT

BY

PAUL PREBLE

Passed Assistant Surgeon, United States Public Health Service

PREPARED BY DIRECTION OF THE SURGEON GENERAL

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A REVIEW OF PUBLIC HEALTH ADMINISTRATION IN MEMPHIS, TENNESSEE.[1]

INTRODUCTION.

The present mayor and commissioners of the city of Memphis were elected upon a "citizen's ticket" and took oath of office January 1, 1920. Provisions of an "ouster" law had permitted frequent changes in the city's administration in recent years and politics had admittedly dominated the affairs of local government, including the public health administration.

Realizing the important functions devolving upon a municipal department of health in a city the size of Memphis and recognizing the need for a careful survey and study of existing conditions and the present machinery operating as the city health department before attempting any plan of reorganization, the present mayor, through the secretary of the State board of health for Tennessee, requested the Surgeon General of the United States Public Health Service to detail an officer for this purpose. Early in his administration the mayor had visited a number of other cities and conferred personally with eminent health authorities associated with several of the well-known institutions where progressive work in public health administration has been undertaken.

Following a conference with the secretary of the State board of health at Nashville, the present survey was commenced on March 30, 1920, and continued until April 19, 1920. It has consisted of a study of organization, activities, and needs, not of individuals.

ACKNOWLEDGMENTS.

It is desired here to acknowledge the valuable assistance and real cooperation received during the period of the survey and the many courtesies shown, particularly by the mayor, the superintendent of health, and other personnel in various departments, in granting free access to all available records and in supplying personal information, opinions, and criticisms, without which the survey would have been incomplete. Acknowledgment is likewise made for the invaluable help and suggestions given by many physicians and others too numerous to mention, but whose interest in the future development of public health activities indicates that the need for a progressive health administration is fully recognized, and to Sanitary Engineer J. K. Hoskins for the preparation of the charts used in this report.

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[1] Editorial note: Since this survey was made, the efficiency of the health department in Memphis has been increased by the reorganization of the work as suggested in the review here published. A full-time superintendent of health has been appointed. Memphis has made splendid progress in improving its health conditions, and now bids fair to have one of the most progressive health departments in any city of its size.

THE CITY OF MEMPHIS.

The city of Memphis is located in the southwestern corner of Tennessee, on the eastern bank of the Mississippi River. It is the largest city in the State, the present population, according to the 1920 census, being 162,351. It was the fourth city of the South in 1910, with a population of 131,105, Birmingham, Atlanta, and New Orleans ranking it in size. In 1910, approximately 40 per cent of the population was colored, and the census of that year showed 26,710 dwellings and a total of 31,154 families. The recent enumeration indicates a normal healthy growth during the past 10 years. Territorial annexations on December 1, 1919, added a population of 11,587. The total land area is about 22 square miles, slightly rolling, with natural drainage to the river and numerous bayous.

Memphis is an important metropolitan city with extensive commercial interests, its present assessed valuation being given at about $200,000,000. It is an important railroad and trading center and is said to be rated as the largest inland hardwood lumber market in the world. It has an extensive market for raw cotton and its various products.

PUBLIC HEALTH ADMINISTRATION IN TENNESSEE.

In order to study in any detail the operation of the local health administration, it seemed desirable to review existing State and local laws, ordinances, and regulations pertaining thereto. The various State and local enactments had not been codified and it therefore became necessary to have them assembled rather laboriously from several sources. Practically all of the procedures and activities of the city health department are based upon local municipal ordinances, provisions of the city charter, and State laws.

State Board of Health.

The Tennessee State Board of Health consists of three physicians appointed by the governor, each member being a regular graduate of medicine, engaged in practice not less than 10 years, one to be selected from each grand division of the State. The State commissioner of agriculture is ex officio a member of the board. The term of office for membership is six years, one new member being appointed every two years. They receive no "per diem" except when epidemic diseases appear in the State.

The secretary of this board is elected by said board for a term of five years, and he is the executive officer with offices at Nashville.

The powers and duties of the State board are set forth in the appendix.

LOCAL BOARDS OF HEALTH.

Under the authority of the acts of 1909 the State legislature makes the following provisions for local boards of health:

SEC. 3101. Every municipality having 5,000 inhabitants or over shall organize a properly constituted board of health, which, in addition to duties as such local boards, shall also make monthly, quarterly, semiannual, and annual reports to and in accordance wtih such form and instructions as said State board of health may prescribe, and also shall make special reports whenever requested.

SEC. 3102. Boards of health established in various cities and towns of the State shall have the same jurisdiction and authority to do all acts in territory extending 1 mile from the corporation, in any direction, that they have within the corporation. * * *

In the case of Ballentine *v.* Polaski (15 Lea, 644, 645) it was declared that the State, county, or cities may be required by statute, at their own respective expense, to take measures to prevent the spread of disease.

HISTORY OF HEALTH ADMINISTRATION IN MEMPHIS.

The history of the municipal government of the city of Memphis is interesting and rather complex. The original charter of 1826 was repealed because of inability to meet the indebtedness arising from the yellow-fever epidemic of 1878. The debt was compromised by the taxing district act of 1879 and subsequent amendatory acts of the State legislature, the local government being resolved back into the body of the State, all offices abolished, and the power of local taxation withdrawn. In 1891 the name "the city of Memphis" was restored and in 1903 the city was again permitted to levy and collect certain taxes. In 1909 the taxing district act was again amended to provide for a commission form of local government and a reorganization of the several municipal functions.

THE ORIGINAL BOARD OF HEALTH.

A "board of health" was created by the taxing district act of 1879, to consist of the "chief of police, a health officer, and one physician, who shall be ex officio president of the board." The local government was empowered to pass all laws necessary for the preservation of health, as indicated in the appendix.

City ordinances passed prior to 1909 also provided for the establishment of a "board of health," to be composed of the "chief of police; one physician, who shall have practiced his profession for not less than five years prior to his appointment; a secretary, who shall be a physician in good standing; and one policeman."

Certain officers of the city were also required to take oath of office and to execute bonds for the faithful performance of their duties, as follows: One meat inspector, $5,000; one food inspector, $500; superintendent of the city hospital, $5,000.

DUTIES OF BOARD OF HEALTH REQUIRED BY ORDINANCES.

The president (provided for under the act of 1879) was required to preside at all meetings of the board, to "see that all health regulations are properly executed" and to make an annual report to the city council.

The health officer (also provided for in the act of 1879, but not specifically designated as such in the ordinances) was required to carry out all the orders of the board, the State laws, and city ordinances. His detailed duties will be found in the appendix.

The secretary was a physician selected by the president, and he apparently was a member of the board. It was his duty to keep all records, books, and papers, to prepare and collect vital statistics, and to make monthly reports to the council. It was also his duty to "visit and attend the sick prisoners in the hands of the city." Under the charge of the secretary, the city was required to maintain a dispensary and provide medicines for indigent persons.

The ordinances pertaining to health and sanitary regulation of the city are quite extensive and detailed and an abstract of the more important requirements will be found in the appendix. Prior to 1909, pure food regulations had been adopted and many ordinances passed governing water-closets and privies and the disposal of night soil.

Early ordinances required the notification of communicable diseases by physicians and others and the registration of births, deaths, and marriages.

BOARD OF HEALTH ABOLISHED.

The board of health for the city of Memphis, originally provided by the taxing district act, was abolished by the act of 1909 (Senate bill 574, ch. 298) amending the city charter as follows:

> SEC. 5. That the board of health (of the city of Memphis) as at present constituted is hereby abolished and in lieu thereof is established a subordinate department to be known as the health department, to be under the supervision and control of the department of public affairs, which said department shall perform the duties and functions heretofore performed by the board of health.

HEALTH DEPARTMENT ESTABLISHED, 1909.

By this act of 1909 there was created a board of commissioners of the city of Memphis, composed of five commissioners, one of whom is the mayor, who serves as commissioner of public affairs and health. There was also organized the departments of fire and police; streets, bridges, and sewers; accounts, finances, and revenues; and public utilities, grounds, and buildings.

The mayor is elected for a term of four years, at a salary of $6,000, and by virtue of his office is commissioner of health and is given "general supervision over the office of superintendent of health and matters relating thereto, including the city hospital, the veterinary surgeon, and all matters properly pertaining to said department."

This act further provides that the board of commissioners shall, among other appointments, include the following with specified terms of office and salaries:

Superintendent of health, 2 years	$3,000
City chemist, 1 year	2,400
City meat inspector, 1 year	1,500
Superintendent of city hospital, 1 year	1,500

No appointive officer or employee of the city is permitted by law to accept any moneys or gifts of any character whatever other than that stipulated for his office, nor may he accept any other office under the city or become an officer or employee (with or without pay) of the State or county in any capacity.

By this law it appears that the appointment, term of office, and salary of the superintendent of health is fixed, although the validity of this law has been questioned.

The department of streets, bridges, and sewers embraces the engineering department, the office of plumbing inspector, street cleaning, and recently took over from the health department the collection of garbage, night soil, and other refuse.

A civil-service commission was provided, to consist of three members, appointed by the commissioners. This commission, under such rules and regulations as may be prescribed by the commissioners, is required to hold examinations to determine the fitness of applicants for positions in the city government. All vacancies that come under civil-service rule are required to be filled by selection from the eligible lists submitted to the city commissioners. Provision is made for temporary appointments, not to exceed 30 days, when the eligible list is reduced to less than three names. The superintendent of health may peremptorily suspend or discharge any subordinate under his direction for neglect of duty or disobedience of orders, such action, with reasons therefor, to be reported in writing to the commissioner of health, who will affirm or revoke such suspension or discharge.

Organization of present city health department.

[Department of public affairs and health: commissioner of health (mayor).]

HEALTH DEPARTMENT.

	Per annum.
Administration:	
Superintendent of health (part time)	[1]$3,000
Secretary (part time)	1,800
Clerk (full time), office	1,200
Maid (full time), colored	600
Division of communicable diseases:	
Clerk (full time)	1,200
Contagious disease inspector (full time)	[1]1,650
Tuberculosis investigator (full time)	[1]1,200
Division of school inspection:	
Supervisor of nurses (full time)	[1]1,440
13 school nurses, white (full time), each	[1]1,200
4 school nurses, colored (full time), each	[1]840
Chemical and bacteriological division (food and milk control):	
City chemist (full time), in charge	2,400
Technician (full time)	1,200
Clerk (full time), salary from special fund	900
Maid (full time), colored	480
3 food inspectors (full time), each	[1]1,200
Dairy inspector (part time)	[1]1,200
Milk inspector (full time)	[1]1,200
Meat inspector (full time)	[1]1,500
Do	[1]1,200
Division of sanitary inspection:	
Chief sanitary inspector (full time)	[1]1,440
15 sanitary inspectors (full time), each	1,200
Miscellaneous:	
Health officer (full time)	[1]1,800
Antinarcotic clinic, physician (part time)	900
Venereal disease clinic, physician (part time)	720
Fresh-air school, physician (part time)	720

TRANSPORTATION.

The secretary, health officer, contagious disease inspector, tuberculosis investigator, and chief sanitary inspector are allowed gasoline, oil, and repairs to their own private automobiles. The dairy and milk inspectors and one sanitary officer are each furnished a Ford roadster with the necessary gasoline, oil, and repairs. One meat inspector is provided with a horse and buggy and an allowance of $15 per month for feed. The other meat inspector is given an allowance of $3 per month for street car fare. The 3 food inspectors and 18 nurses are allowed necessary fares on street cars.

The exact cost for automobile upkeep, including gasoline, oil, and repairs to the cars mentioned in the above paragraph could not be determined, but apparently these items for the calendar year 1919 amounted to about $4,350 for nine cars, three of which are owned by the city. In addition, about $879 was expended for street car fares and horseshoeing. An item of approximately $5,246 for transportation expenses seems excessive, and an investigation of these expenditures is under way.

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[1] Transportation allowance not included.

Financial report, 1919.

	Expended, 1919.	Estimates, 1920.
Administrative division:		
Salaries	$7,150.00	$8,000.00
Supplies	828.99	828.00
Ice	133.78	135.00
Reports, monthly and annual	314.25	480.00
Telegrams	8.85	25.00
Long-distance telephone	.70	1.00
Auto repairs and supplies	206.32	205.00
Engineering department (auto repairs)	403.24	402.00
Miscellaneous	12.28	13.00
	9,058.41	10,089.00
Chemical and bacteriological department:		
Salaries	11,437.50	11,440.00
Drugs	672.58	672.00
Ice	86.00	86.00
Gas	43.76	43.00
Auto repairs and supplies	829.55	825.00
Engineering department (auto repairs)	1,157.88	1,156.00
Street car fares	120.75	125.00
Horse shoeing and feed	214.00	214.00
Miscellaneous	143.32	145.00
	14,705.34	14,706.00
Meat inspector:		
Salary	1,500.00	1,500.00
Supplies	15.50	40.00
Car fares	36.00	36.00
	1,551.50	1,576.00
Sanitary department:		
Salaries	16,568.12	19,440.00
Supplies	100.95	101.00
Auto repairs and supplies	154.67	157.00
Engineering department (auto repairs)	286.78	186.00
	17,110.52	19,884.00
Dispensary:		
Salaries	3,659.00	6,240.00
Telephone	121.09	120.00
Dispensary—Continued.		
Drugs	$4.25	$5.00
Laundry	.31	4.00
Gasoline	187.50	300.00
	3,972.15	6,669.00
Visiting nurses:		
Salaries	16,471.26	20,400.00
Car fares	689.99	890.00
Associated charities	5,000.00	5,000.00
Public Health Nursing Association	3,947.59	6,500.00
	26,108.84	32,790.00
Contagious disease department:		
Salaries	1,600.00	1,650.00
Meningitis serum	4.50	5.00
Pasteur treatment	929.40	1,000.00
Diphtheria antitoxin	258.86	260.00
Drugs	133.48	130.00
Vaccine	450.29	450.00
Formaldehyde	1,366.69	1,500.00
Supplies	568.86	568.00
Tetanus serum	31.54	30.00
Typhoid fever vaccine	1,410.70	1,000 00
Ambulance	337.00	350.00
Auto repairs and supplies	404.53	313.00
Engineering department (auto repairs)	378.05	378.00
Board for tubercular patients	42.90	....
Laundry	1.05	1.00
	7,917.85	7,635.00
Mosquito campaign:		
Salaries	5,113.34	....
Hardware	79.65	....
Oats	54.00	....
Supplies	66.09	....
Oil	454.51	....
Kerosene	39.88	....
Auto repairs and supplies	115.27	....
Engineering department (auto repairs)	358.06	....
	6,280.80	....

SUMMARY, 1919.

	Salaries.	Expenses.	Total.
Administration division	$7,150.00	$1,908.41	$9,058.41
Chemical and bacteriological division	11,437.50	3,267.84	14,705.34
Meat inspection	1,500.00	51.50	1,551.50
Sanitary department	16,568.12	542.40	17,110.52
Dispensary	3,659.00	313.15	3,972.15
Visiting nurses	16,471.26	9,637.58	26,108.84
Contagious disease department	1,600.00	6,317.85	7,917.85
Mosquito campaign	5,113.34	1,167.46	6,280.80
Total	63,499.22	23,206.19	86,705.41

RECEIPTS, 1919.

Chemical and bacteriological department, tuberculin tests	$17.50
Administrative division, midwife examinations	35.00
Sanitary department, damage to car from street railway company	30.00
Mosquito campaign, sale empty grease barrels	7.00
Contagious disease division:	
Sale empty formaldehyde barrels	37.50
Pasteur treatments	232.20
Total receipts	359.20

In 1918 the total expenditures for the health department and garbage collection amounted to $186,743.61, and of this $115,698.15 was credited to the cost of garbage collection, leaving a balance of $71,045.46 for the maintenance of the health department. The expenditures of this department for 1919 were therefore increased by $15,659.95.

It is difficult to analyze these expenditures for health activities, as will be indicated later, and to correlate them with results accomplished. The total expenditure for 1919 represents approximately 55 cents per capita and should permit a reasonably adequate organization.

FINANCIAL AID TO NONOFFICIAL AGENCIES.

An allotment or grant of $5,000 is made each year to the associated charities organization and about $600 each month to the Public Health Nursing Association, apparently releasing the city from any further obligation of caring for the indigent sick and needy. The city has no voice or control over the expenditure of these grants and no supervision over the health activities of these organizations.

As a link between the city hospital and the associated charities a medical social service is being developed to provide for the indigent cases after discharge from the hospital. This service will tie up discharged cases with the out-patient department of the university. In this connection cases are sometimes referred to the Public Health Nursing Association.

While provision for aid to indigent sick is a function of the city, the health department is concerned only with communicable infections. There should, however, be harmonious cooperation between the several agencies concerned in the care of the indigent sick, and if the grants previously mentioned continue to be made and are charged against the expenditures of the health department, a definite program should be developed and the activities of these private organizations should be placed at the disposal of the health department to the extent that they are concerned with purely public health problems.

OFFICE AND RECORDS.

The offices of the city health department are located in the basement floor of the county building, near the center of the city. One large room about 50 by 60 feet is divided by means of false partitions into six small rooms, one of which serves as a waiting room. The office clerk occupies one outside room, the communicable disease clerk and the nurses another. The small central outside room is a general office for use of sanitary inspectors and others. One inside room with no natural lighting contains the desk of the chief sanitary inspector and serves as a general office for the "health officer" for purposes of vaccinations, examinations, etc. The other inside room was formerly used as an office for the registrar of vital statistics, but at the present time largely as a storage room. The office of the superintendent of health is a very small room located in a corridor connecting with the clerk's office.

The laboratory occupies two fair-sized adjoining rooms and is fairly well equipped for the work undertaken.

There is practically no library for reference purposes. The records of births and deaths are kept in two unprotected cabinets in the general office with the exception of more recent unbound certificates which are filed in a portable wooden closet. All records of communicable diseases reported and visited and the reports of the nurses are filed in the room used by the communicable disease clerk. At the end of each calendar year and after the material has been assembled for the annual report, some of the records are stored in the basement. There is one typewriter, a small multigraph machine, and a refrigerator for storing vaccines, antitoxins, etc.

The offices are open week days from 8 a. m. until 5 p. m., except on Saturdays when they close at noon. There is no one on duty in the offices on Sundays and holdiays except occasionally in the laboratory for such necessary work as may be required. The sanitary inspectors report at the office at 8 a. m. for any special instructions and then proceed to their districts. The nurses arrive at the schools at 9 a. m.

The present offices are cramped and inadequately equipped. It is planned to move the entire department to the new city auditorium, which, it is understood, will be completed in about 18 months.

ACTIVITIES OF HEALTH DEPARTMENT.

The health activities of the city of Memphis have been administered under the direction of a part-time executive, designated since 1909 as the superintendent of health and appointed by the mayor for a specified term of two years at a fixed salary of $3,000 per annum.

A review of city ordinances adopted for the preservation of health and the regulation of sanitation would seem to indicate that the importance of such functions had been recognized early, fairly comprehensive measures appearing in the act of 1879, creating the taxing district. The yellow fever epidemic in the seventies undoubtedly served to direct attention to the urgent need for proper sanitary laws. A sewerage system was started in 1879, and over 70 miles of mains had been laid prior to the close of 1898. In 1903 the city purchased its water supply system, there being at this time 17,213 connections with an average daily consumption of approximately 13,000,000 gallons.

The health department early inherited supervision over the collection and disposal of garbage and refuse and the alley cleaning department was added to its functions in 1910. In that year street cleaning was transferred to the engineering department and early in 1920 garbage collection and disposal and the alley cleaning department (for the collection and disposal of night soil) was given over to the department of streets, bridges, and sewers where it more properly belongs.

The relative or assumed importance of sanitary inspection is indicated by the early development of a division of sanitary inspection. In 1898 a force of 4 inspectors had been increased to 13. This division has been continued up to the present time. Until 1898 it had been placed in charge of a physician in part-time service.

A chemical and bacteriological laboratory was also established about 1898, in charge of a city chemist, and a city hospital was erected in about the same year with a city dispensary operating in the central police station for first aid and emergency medical and surgical treatment.

School inspection was first inaugurated in 1908 with one part-time physician. In 1910 this division had been increased to 13 physicians, all part-time, and in the following year 4 more physicians and 4 nurses were added. This large medical personnel was discontinued in 1916, since which time the work at the schools has been carried on by a force of 18 nurses and one part-time physician whose services were discontinued March 1, 1920.

From such data and information as it has been possible to assemble during the present survey, it would appear that the expansion of public health activities in Memphis has been influenced to a considerable degree by political conditions. Many of the personnel "put on the pay roll" of the health department have received their appointments rather because of certain political considerations and not because of their special experience and training or other qualifications that might be adaptable to public health work.

With these past conditions in mind, it is not difficult to visualize the status and efficiency of the organization and its activities up to the present time. It would be more difficult to express in terms of sickness prevented and lives saved the real value of such an organization, although published annual reports may indicate statistically a considerable activity along certain lines.

It is believed that, in addition to the retarding influence of political indifference to the important functions that should be carried on by a city health department, perhaps the real reason for the lack of further progress is the fact that the administration of health affairs has been delegated to part-time, busy practicing physicians, who, even though competent or desirous of promoting the health interests of the city, have been seriously handicapped not only by personal obligations extraneous to municipal service but by the complexion of the personnel placed under their direction. Rather frequent changes in the position of chief executive, part-time service, friction, and lack of interest and ability on the part of subordinate personnel have all mitigated against the adoption of a more progressive plan of action. These criticisms are directed to the system and are not intended as reflections upon individuals.

In attempting a review of the present organization and activities of the health department, the following presentation has been based upon personal interviews with nearly all of the present personnel and, in addition, with many physicians and others especially interested in and having personal knowledge of local conditions and needs, and also upon a careful study and digest of published reports and such records and data as were found available.

I. ADMINISTRATION.

SUPERINTENDENT OF HEALTH.

The position of superintendent of health was created apparently de novo by the act of 1909, the appointment to be made by the board of city commissioners. The present incumbent has served in this position since 1915 with the exception of a short absence on military duty. He had previously served as chief sanitary inspector from about 1898 to 1901. He again occupied this position in 1904 and served as secretary from 1905 to 1908 and as superintendent for the years 1908 and 1909. Until recent months, superintendents of health have been on duty officially an average of about one hour each day.

The qualifications and duties of the superintendent are not set forth in the act of 1909 which reorganized the health department, nor is any mention made of this position as such in the city ordinances or charter. The board of health, which was abolished, included a health officer as a member of the board, and city ordinances prior to 1909 specify his duties but are not clear how the title was established.

There appear to be confusion and inconsistencies in the sections of the various legislative acts and city ordinances relating to the chief executive of the health department, and the technical legal phases of this situation should be carefully considered. The present health department is held responsible for the performance of the duties and functions as previously prescribed for the board of health, but the exact status of the superintendent does not seem to be clearly defined. In practice, however, the superintendent has occupied the position of the executive head of the department, under the direction of the mayor, as commissioner of health, and the duties formerly required of the board of health have been assigned to him. The several duties required of the previous board of health, and which are probably still in force, have been abstracted and will be found in the appendix.

There is no particular evidence to indicate that in the past any considerable time has been given to the duties of this important office, and for obvious reasons. Except in times of epidemics or similar occasions of special emergency, the routine activities of the several divisions as organized have been largely left to subordinates. Special measures have from time to time engaged the personal attention of the chief executive.

The responsibility for the operation of the affairs of this department does not rest alone with the superintendent of health. A large share of this responsibility must be placed upon the municipal authorities who have controlled the policy and personnel of this department.

SECRETARY.

The position of secretary was created by the taxing district act of 1879. Under the provisions of this act it was required that he be a physician, and certain duties were assigned to him by city ordinances. As a member of the board of health this position appears to have been abolished by the act of 1909, although the title has been continued up to the present time.

The secretary has apparently always been employed on part-time service, and, as his duties are largely concerned with the control of communicable diseases, his activities will be considered later in the discussion of that function.

HEALTH OFFICER.

The position of health officer was likewise created by the taxing district act, and under the provisions of the city ordinances he appears to have been the executive officer of the board. When the original board of health was abolished and the present health department established in 1909 the newly created position of superintendent of health assumed the duties previously delegated to the health officer. Under the organization of the health department, the health officer does not appear to have been assigned to any regular division of activities, and this position, prior to March, 1920, was filled by part-time physicians. For this reason the duties of the health officer will be discussed here.

Beginning March 1, 1920, this position has been filled by a full-time physician, who had previously served as school inspector from 1910 to 1915. The present salary is $1,800, and in addition he is allowed gasoline, oil, and repairs for his private automobile.

The present health officer visits a few of the communicable diseases reported for the purpose of confirming diagnosis. When called by school nurses he also visits cases, to establish diagnosis.

A considerable portion of his time is taken up in vaccinating against smallpox at the city office. School children and contacts required to be vaccinated receive this service free. He also administers antirabic treatment when necessary. Vaccinations against typhoid fever will be undertaken during the summer months.

Physical examinations of minor children who are being placed in employment are made by the health officer and the proper certificate issued. Between three and four hundred of these examinations have been performed annually.

OFFICE MANAGEMENT.

One clerk is on duty in general charge of the office affairs, although she does not appear to assume any special authority. Her present salary is $100 per month. It is her duty to perform such stenographic services as are necessary, and to keep such records, schedules of expenditures, and pay rolls as are required.

Beginning April 1, 1920, she became deputy registrar of vital statistics, and for these services receives $30 each month by special arrangement with the registrar, who is appointed by the State and has no connection with the health department. Practically all of the certificates of births and deaths are received by the deputy registrar, who issues the required burial permits.

One maid, colored, has been employed in the office for about 14 years for general office and messenger service at a present salary of $50 per month. She is quite familiar with office routine and records, and her services have undoubtedly been worthy of the hire.

The communicable disease clerk, although on duty full time in the office, will be discussed under the section on communicable diseases.

Phone calls registering complaints, reporting communicable diseases, and other matters referred to the health department are received by whoever may be available at the time of call.

PUBLICATIONS.

Monthly report.—There is issued each month a "mortality report," consisting of four pages about 8 by 10 inches in size. The first page contains only the names of the commissioners and certain officers of the department. There follows a table giving the causes of deaths that have occurred during the month by color and age groups. The total numbers of births and cases of communicable diseases reported are recorded. Statistical summaries of the monthly reports made by the chief sanitary inspector, city chemist, milk and food inspectors, contagious disease inspector, supervisor of nurses, and other special reports of like nature are included.

In these monthly reports, covering a period of about two years, there has been no attempt at any discussion of pertinent health problems or effort made to reach the general public in any campaign of popular education in public health matters. About 300 copies are mailed each month to physicians and other health departments.

Annual report.—The Fortieth Annual Report of the department was published in 1918. These reports are now merely statistical compilation of births and deaths and include summary reports of the several divisions. Accumulative tables of total deaths and deaths from several causes have been continued each year. There has been for a number of years no general discussion of activities, and these reports appear to have been edited as a more or less perfunctory repetition of previous reports. The same summaries have been continued from year to year and in themselves would indicate but little real progress. Many errors will be found in the statistical tables and it was not found possible to check the figures given with previous original records.

Other publications.—As far as could be determined, no studied program of publicity has been undertaken. A few leaflets on some of the more common communicable diseases have been printed and used in connection with control measures undertaken.

In reorganizing and expanding the activities of this department, careful attention should be given to publicity through all the available channels in order to educate the public, and particularly the individual, in matters pertaining to personal hygiene and disease prevention in general.

Sanitary code.—The various State laws, legislative enactments, and city ordinances pertaining to public-health matters have never been codified and the files of the health department did not contain a complete set of them. A brief review of these laws and ordinances indicates at once the necessity for a careful study and revision in order to straighten out many apparent inconsistencies and bring them up to date. The revised and extended health ordinances and regulations should then be codified and made readily available in convenient printed form for reference and distribution among physicians and others concerned in their enforcement.

II. VITAL STATISTICS.

The State vital statistics act of 1913 created a central bureau of vital statistics under the supervision of the secretary of the State board of health. Each city, incorporated town, and civil district in the State became a primary registration district, and the assistant secretary of the State board of health was made registrar for the State. Local registrars are appointed in each primary district, and they are authorized to appoint deputy registrars. The model law for vital statistics is followed, and the revised United States standard certificate of death, approved by the United States Bureau of the Census, is used.

REGISTRATION OF BIRTHS AND DEATHS.

On April 1, 1920, a physician was appointed local registrar, the position having been filled previously by a layman. The health department office clerk was appointed deputy registrar and attends to practically all the business of this office.

From 1848 to 1905 transcripts of original death certificates were made in large registers and are filed in the health office. From 1906 to 1913 the original certificates have been bound in cloth and filed chronologically. Since 1913 transcripts have been made, the originals having been forwarded to the State registrar each month. Some of the recent records have been lost. Many of the transcripts are poorly made and often illegible, and apparently no special care or attention has been given to correctness of diagnosis or completeness of records.

Birth records since 1886 have been recorded in a similar manner and are often incomplete. It has been estimated that probably about 75 per cent of all births are being reported. Deaths are probably nearly all reported.

The health department has had free access to the registrar's records, as this official has been given office space in the department's offices. The records of births and deaths have been kept also in registers for the use of the health department, although at the beginning of the present survey the records for the past two years had not been copied.

As far as could be determined, no special tabulations or study of these records have been made except the tables included in the monthly and annual reports of the department.

Greater care should be exercised in securing more accurate statements as to causes of death; and it is believed that it would be desirable to have the registration of births and deaths placed directly in the hands of the health department.

Chart I gives the curves for the total death rates from 1900 to 1919 and the curves for total deaths by color for this period. There has been during this period no tendency toward a decreasing death rate, and it will be noted that the colored death rate has progressively increased. This fact should receive serious consideration and efforts should be made to reduce this increasing mortality among the colored population.

Because of local hospital facilities there are undoubtedly many deaths of nonresidents included in the records for the city of Memphis. It was found difficult and in many cases impossible to pick out the nonresident deaths on account of incompleteness of data supplied on the certificates. Attempts to determine the number of nonresident deaths for the years 1916 and 1917 from the records failed to check even reasonably close with the table published in the annual report of the department.

TABLE I.—*Showing total births and deaths reported by color, 1909–1918, city of Memphis.*

Year.	Births.			Deaths.		
	White.	Colored.	Total.	White.	Colored.	Total.
1909	1,299	721	2,020	1,107	1,239	2,346
1910	1,853	987	2,840	1,329	1,489	2,818
1911	1,780	930	2,710	1,328	1,505	2,833
1912	852	405	1,257	1,332	1,647	2,979
1913	1,757	748	2,505	1,262	1,496	2,758
1914	1,438	697	2,135	1,299	1,690	2,989
1915	1,438	697	[1] 2,135	1,303	1,597	2,900
1916	1,580	715	2,295	1,216	1,427	2,643
1917	1,588	773	2,361	1,399	1,559	2,958
1918	1,480	540	2,020	1,831	1,732	3,563

[1] Total births by color for 1915 are the same as those published for 1914, obviously an error.

NOTE.—The above figures are taken from the annual reports of the health department and are subject to revision.

CONTROL OF MIDWIFERY.

An ordinance passed in 1910 provides for the regulation of the practice of midwifery by the issuance of a permit after applicants have passed a satisfactory examination prescribed and conducted by the superintendent of health, with a fee of $5. As far as could be determined there has been no very effective control over midwives.

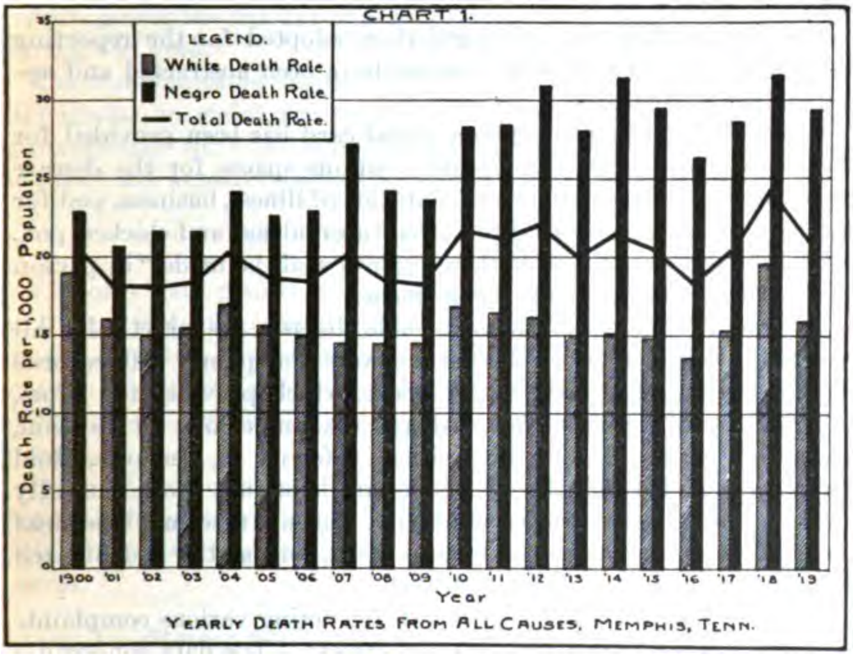
III. CONTROL OF COMMUNICABLE DISEASES.

The prevention and control of communicable diseases is considered the most important function of a modern health department.

Many boards of health, even to-day, have been established and are being operated on the theory that the control of communicable diseases depends largely upon successful sanitary regulation of the environment, and for this reason large sums of money and great expenditures of energy have been directed to all sorts of nuisances and conditions of filth as being responsible for the origin and spread of many diseases.

Preventive medicine has pointed out the more vital importance of controlling the individual who is sick or may be infected with any communicable disease. It is the individual, therefore, that becomes the dangerous focus from which disease is spread, and in the measures adopted for the control of communicable disease, activities must be directed toward the individual rather than the environment, and the division of communicable disease, therefore, becomes the most important division in the modern health department.

CHART 1.



YEARLY DEATH RATES FROM ALL CAUSES, MEMPHIS, TENN.

In Memphis at the present time there is no well-defined division for the control of communicable disease. The various activities that ordinarily are associated with such a division will be considered here. This will include morbidity reporting, the duties of the secretary, health officer, contagious-disease inspector, sanitary officer, school nurses, and the diagnostic laboratory.

[illegible] reporting [illegible]

[illegible] reporting [illegible] and ap- [illegible] provided for [illegible] forms [illegible] and for [illegible] year [illegible]

[illegible] annually all [illegible] and month [illegible] for more, [illegible] In addition, [illegible] final [illegible] usually [illegible] loose-leaf [illegible] out of each [illegible]

[illegible] complaints [illegible] concerning [illegible]

[illegible] slip [illegible] daily report, [illegible] and [illegible] for each [illegible] foreign- [illegible] for [illegible] Thus [illegible] alphabetic [illegible] of solution, [illegible] which time another card (3 by 5) is made out (3) to show when leased for fumigation, street, house, by whom fumigated, date, and marks. After report of fumigation, the card is also filed in the ice.

The communicable disease clerk also receives and files reports of ereal diseases on a form provided by the division of venereal dis-s, United States Public Health Service. These report blanks supplied to the physicians, and the return blank is mailable un-penalty frank, requiring no postage. A weekly return of these is made to the State board of health.

ere is also prepared and mailed each week to the Surgeon Gen-of the Public Health Service the municipal weekly morbidity rt, giving the number of cases of communicable diseases reported g the week.

communicable disease clerk also keeps the registers of births eaths, in which are copied transcripts of the records kept by egistrar of vital statistics. She also receives all copy for ly and annual reports and prepares it for the printer.

PERCENTAGE OF CASES REPORTED.

only data readily available that would permit of an estimate percentage of cases reported are the tables published in the reports. From these records it would appear that the per-of reporting for the more common diseases has been only tisfactory at times, and varies rather noticeably from year

II was compiled from data printed in the annual reports. the diseases listed would appear to have been fairly com-reported in some years. It was not possible to check these

II.—*Showing total cases and deaths reported for certain diseases, Memphis, Tenn., 1909–1919.*

ases.	1909		1910		1911		1912		1913		1914	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
gh	......	......	......	......	......	......	......	......	100	13	(1)	......
	226	11	176	7	94	3	41	2	101	12	143	2
	244	16	185	13	125	15	108	10	114	17	170	20
	......	......	190	36	623	82	634	67	284	49	427	59
	......	......	......	......	167	320	160	275	347	334	335	390
	340	3	265	......	198	1	15	......	84	......	33	......
	......	......	......	......	101	2	124	......	264	......	122	......
	......	......	......	......	1,277	9	450	1	753	4	1,136	6

annual reports for 1914 and 1915, the same totals of cases of the diseases are th reports, obviously an error. Similar errors have occurred in other reports ently the accuracy of the figures taken from these reports can not be vouched as not been possible to check them with original records.

TABLE II.—*Showing total cases and deaths reported for certain diseases, Memphis, Tenn., 1909–1919*—Continued.

Diseases.	1915		1916		1917		1918		1919	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Whooping cough	(1)	......	31	2	400	11	72	8	......	......
Scarlet fever	143	5	157	6	177	4	147	2	......	......
Diphtheria	170	14	314	17	474	23	210	12	......	......
Typhoid fever	427	38	512	72	248	32	118	23	......	......
Tuberculosis	335	361	826	394	770	408	778	406	[2] 441	[2] 342
Smallpox	33	......	23	......	361	......	327	......	......	......
Chicken pox	122	......	269	......	269	......	172	......	......	......
Measles	1,136	1	523	......	2,640	15	519	4	......	......

[1] In the annual reports for 1914 and 1915, the same totals of cases of the diseases are found in both reports, obviously an error. Similar errors have occurred in other reports and consequently the accuracy of the figures taken from these reports can not be vouched for as it has not been possible to check them with original records.

[2] From monthly reports.

In attempting a review of the control measures carried out at the present time it was found that there appears to exist but little coordination of the various control activities under any one head or authority. An outline of the work carried on by several officers and divisions will follow.

PLACARDING.

One sanitary inspector who has been detailed as and known as the sanitary officer is given the printed slips (1) already mentioned, and he proceeds at once to the proper address and placards the cases reported. This placard bears the name of the disease. He is instructed to inquire concerning the number of school children and adults employed who reside at the place of residence in which has occurred a communicable disease. He also is required to ascertain the source of the milk used by the patient and whether the house is screened, noting all these facts upon the slip, which he returns to the office.

This officer is said to revisit cases when there is doubt as to the observance of isolation, and also to remove the placard at the termination of the case. It was stated that all cases reported are placarded, with the exception of tuberculosis, malaria, and mumps. It is believed that the placarding constitutes the principal function of this officer. He is apparently not qualified to perform functions connected with epidemiologic study.

ISOLATION.

The posting of a placard is intended as a warning of the existence of communicable disease, and to establish a period of isolation, in scarlet fever three weeks or more; in measles not less than 15 days.

The contagious-disease inspector, who is a layman of over 20 years' service in the department, states that he visits all reported cases of smallpox, cerebrospinal meningitis, diphtheria, scarlet fever, and typhoid fever, and placards some of them. Upon the first visit to any of the first four diseases mentioned the breadwinner is notified to present himself at the health office in order to secure a permit to continue his employment. If school children are found residing at placarded premises their names and the name of the school attended are reported to the office.

He states also that he issues instructions that all cases must be isolated, and he is provided with one-page printed instructions to be left at all cases of scarlet fever and measles. Instruction folders formerly distributed by this inspector for the management of cases of typhoid fever and diphtheria have not been used for some time. In previous years several antifly leaflets and posters have been used.

The contagious-disease inspector revisits placarded premises occasionally, but it is difficult to believe that satisfactory and effective observance of isolation can be assured in many cases.

FUMIGATION.

It is the duty of the contagious-disease inspector to fumigate after the termination of cases of diphtheria, scarlet fever, smallpox, cerebrospinal meningitis, typhoid fever, and tuberculosis, and occasionally for other conditions. The following routine is carried out: About 8 ounces of formalin per 1,000 cubic feet of space is sprayed by means of a hand pump over such articles as mattresses, carpets, linen, etc., and the occupant is directed to air the rooms after 8 hours and then clean up the room or rooms. It was stated that this use of formalin made a general cleaning up rather necessary.

For cases of typhoid fever, during the course of the disease, it has been the practice to furnish chloride of lime as a disinfectant for discharges, toilets, etc. This disinfectant is also freely used when cellars have been polluted with sewage.

HOSPITALIZATION.

The Memphis General Hospital is owned by the city and operated by a board of trustees in connection with the University of Tennessee. It has a maximum capacity of about 210 beds and accepts cases of typhoid fever.

Three small frame buildings in the rear of the city hospital are used as a communicable disease hospital. The small central building serves as quarters for a nurse who is on continuous duty during her detail. In one of the ward buildings there is a small office and a diet kitchen, and in both ward buildings five rooms holding three beds each, rather poorly furnished and heated with open grates. Scarlet fever, diphtheria, measles, chicken pox, and erysipelas cases are received here.

Smallpox cases are cared for at a pest house owned and operated by the Shelby County authorities and located about 6 miles from the city. There are about 30 beds available here and cases are transferred by a private ambulance at the city's expense.

Present facilities for the hospitalization of cases of communicable diseases are manifestly most inadequate. It would be possible to care for only 15 cases in the small communicable disease hospital, provided the sex, color, and disease happened to correspond to the available number of rooms.

Provisions should be made at once for the erection of a suitable hospital for the care of cases of communicable disease, with a minimum capacity of at least 100 beds, and it should be located preferably on the grounds of the city hospital.

DUTIES OF SECRETARY.

The principal function of the secretary to the health department consists in visiting reported cases of smallpox and such diseases as meningitis and infantile paralysis, in order to establish diagnosis.

When a diagnosis of smallpox is established the case is usually removed to the pesthouse unless conditions at the place of residence warrant isolation at home. The sanitary officer proceeds to serve vaccination notices to all families or households in the block where smallpox is found, ordering all persons therein to be immediately vaccinated either at the health office or by private physicians.

It was stated that isolation was probably not very effectively carried out in many of the cases treated at home. The secretary makes an effort to vaccinate all possible contacts.

The secretary also is required to compile data for the monthly and annual reports. He has no regular hours of duty, but answers calls from physicians and the health office. He has served as secretary or health officer for a number of years.

The duties of the health officer in connection with communicable disease have already been described.

PUBLIC-HEALTH NURSING.

During the school term the health department nurses are on duty at the schools from 9 a. m. to 3 p. m. From 3 p. m. until about 5 p. m. their time is spent in visiting absentees and such cases of scarlet fever, diphtheria, typhoid fever, and malaria as may occur in their districts. The city is divided into about 16 school districts and each nurse is assigned one or more of these districts.

At the close of school hours the nurse usually calls the health office for records of cases of communicable diseases reported in her district, and within the time then at her disposal she pays visits to these cases and secures certain epidemiologic data on mimeographed forms provided for the purpose.

When the communicable disease inspector, secretary, or other officer finds school children in families having a case of any communicable disease he notifies the office and a form post card giving the necessary information is mailed by the communicable disease clerk to the school attended and the exclusion of the children follows.

During the period of the year when the schools are closed the nurse's time is divide between follow-up work from school records and public-health nursing visits in connection with communicable diseases. Just how effective this latter work has been could not be determined.

The following summary of "follow-up" work appears in the annual report of the health department for 1918, the last report available:

Public health nursing activities, 1918.

Number of visits made to investigate tuberculosis	1,887
Number of visits made to typhoid fever	83
Number of visits made to investigate scarlet fever	140
Number of visits made to investigate diphtheria	210
Number of visits made to investigate other diseases	2,232
Number of cultures taken for diphtheria (diagnostic and release)	877
Number of cultures taken for Widal	26
Number of smears for malaria	53
Number of instruction visits	2,380
Number miscellaneous visits	2,671
Number nursing visits to influenza	944
Number children sent to hospitals for operations	54
Number referred to all clinics	690
Number sent to hospitals, influenza	120
Number referred to charities	79
Secured glasses for	13
Referred to visiting nurses' association	152
Calls transferred to juvenile court	4
Total calls made	11,503

DIAGNOSTIC LABORATORY.

The following summary for the year 1918 indicates the character of the examinations made in the health department laboratory for diagnostic purposes:

	Positive.	Negative.
Diagnostic cultures for diphtheria	198	2,388
Release cultures for diphtheria	198	464
Blood for Widal reaction	52	745
Blood for plasmodium	59	504
Sputum for tubercle bacillus	195	530
Specimens for typhoid release	2	84
Heads for negrii bodies	25	28
Total	729	4,743

There are about 10 private laboratories in the city, and it was apparent that physicians generally do not patronize the city laboratory to any great extent. In the above summary many of the diphtheria cultures (877) were secured by the city nurses, and many of the specimens examined for the Widal reaction were secured during a special search made for typhoid carriers.

Physicians should be encouraged to use and rely upon the health department laboratory for diagnostic purposes and facilities for all routine and special examinations, including the Wassermann test, should be provided. The present city chemist is required to devote too much of his time to other activities.

DIPHTHERIA.

The routine meaures of placarding and disinfection have already been briefly outlined. School children are required to remain away from school until after disinfection.

The school nurses visit all cases reported, give instruction for proper care of patients and bedside prophylaxis, determine possible contacts, and note certain epidemiologic data for each case. They frequently secure throat cultures for diagnosis and release.

Two negative cultures are required before patients are released and one negative culture for contacts. These cultures are examined in the health department laboratory. Blanks and swabs are supplied also to physicians, and the results of examinations are phoned to the physicians and the blank filed. A substation is maintained at a central drug store, where swabs can be secured and diphtheria antitoxin is furnished free to physicians for indigent cases. Druggists are supposed to furnish to the health department a record of all antitoxin sold.

TUBERCULOSIS.

As will be seen by reference to Table III, tuberculosis is very incompletely reported, and as far as could be determined there has been no continuous or extensive effort made to reduce the morbidity and mortality rates from this disease.

In 1909, through the efforts of the department of health, private funds were secured which permitted the opening of some small cottages that had previously been erected for yellow fever patients. This institution served as a tuberculosis hospital until September, 1919, at which time it was destroyed by fire. In 1918, 148 cases were admitted, and 94 deaths occurred during that year.

A hospital for the treatment of tuberculosis, to be known as Oakville Sanatorium, is soon to be erected by joint action of the city and county authorities and operated under the direction of a board of trustees. A superintendent has already been appointed, and for the present is in charge of a dispensary for tubercular cases maintained in the out-patient department of the city hospital by arrangement with the University of Tennessee. The salary of this superintendent is to be paid from funds secured through a bond issue floated for the construction and operation of the sanatorium.

A social worker was engaged in tuberculosis work for about three years, but this activity was discontinued in April, 1920. Some field work has been undertaken by the school nurses, 1,887 visits being made in 1918, and only 707 in 1919.

A fresh-air school is maintained by the board of education, with an enrollment of about 25 children with definite or suspected infections. One health department nurse is on duty here from about 8 a. m. to 3 p. m., the balance of her time being devoted to follow-up visits in the homes of these children. A physician is engaged in part-time service for general attendance, physical examinations, and medical supervision.

A dispensary was maintained at the police station until recently, when by arrangement the "city dispensary" became part of the out-patient department of the University of Tennessee Medical School.

The Public Health Nursing Association, a private organization, cared for 82 cases of tuberculosis during the year 1919.

A fresh-air camp has been maintained at the fair grounds for several years and five or six children have been cared for there.

The Shelby County Tuberculosis Association, a private organization, has performed some nursing of tubercular patients, and plans are under way for the construction of a preventorium near the Oakville Sanatorium.

TABLE III.—*Deaths and death rates from tuberculosis (all forms) by color, Memphis, 1901–1918.*

Years.	Deaths.			Death rates per 100,000.		
	Total.	White.	Colored.	Total.	White.	Colored.
1901	256			242.1		
1902	296			272.4		
1903	217			194.5		
1904	272			237.7		
1905	295			251.6		
1906	268	115	153	223.0	167.8	296.3
1907	257	93	164	208.8	130.6	316.2
1908	274	100	174	217.5	135.5	334.0
1909	289	109	180	224.5	142.5	344.0
1910	350	127	223	266.1	160.9	424.3
1911	321	117	204	240.4	144.9	386.7
1912	349	133	216	257.4	161.2	407.1
1913	374	133	241	271.8	157.8	452.1
1914	429	107	322	307.3	124.3	601.2
1915	425	125	300	300.0	142.3	557.4
1916	390	87	303	271.7	97.2	560.4
1917	412	133	279	286.8	145.7	513.8
1918	449	141	308	303.8	151.4	562.6

Greater care should be exercised in securing more accurate statements as to causes of death; and it is believed that it would be desirable to have the registration of births and deaths placed directly in the hands of the health department.

Chart I gives the curves for the total death rates from 1900 to 1919 and the curves for total deaths by color for this period. There has been during this period no tendency toward a decreasing death rate, and it will be noted that the colored death rate has progressively increased. This fact should receive serious consideration and efforts should be made to reduce this increasing mortality among the colored population.

Because of local hospital facilities there are undoubtedly many deaths of nonresidents included in the records for the city of Memphis. It was found difficult and in many cases impossible to pick out the nonresident deaths on account of incompleteness of data supplied on the certificates. Attempts to determine the number of nonresident deaths for the years 1916 and 1917 from the records failed to check even reasonably close with the table published in the annual report of the department.

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1910	1,853	987	2,840	1,329	1,489	2,818
1911	1,780	930	2,710	1,328	1,505	2,833
1912	852	405	1,257	1,332	1,647	2,979
1913	1,757	748	2,505	1,262	1,496	2,758
1914	1,438	697	2,185	1,299	1,690	2,989
1915	1,438	697	[1] 2,135	1,303	1,597	2,900
1916	1,580	715	2,295	1,216	1,427	2,643
1917	1,588	773	2,361	1,399	1,559	2,958
1918	1,480	540	2,020	1,831	1,732	3,563

[1] Total births by color for 1915 are the same as those published for 1914, obviously an error.

NOTE.—The above figures are taken from the annual reports of the health department and are subject to revision.

CONTROL OF MIDWIFERY.

An ordinance passed in 1910 provides for the regulation of the practice of midwifery by the issuance of a permit after applicants have passed a satisfactory examination prescribed and conducted by the superintendent of health, with a fee of $5. As far as could be determined there has been no very effective control over midwives.

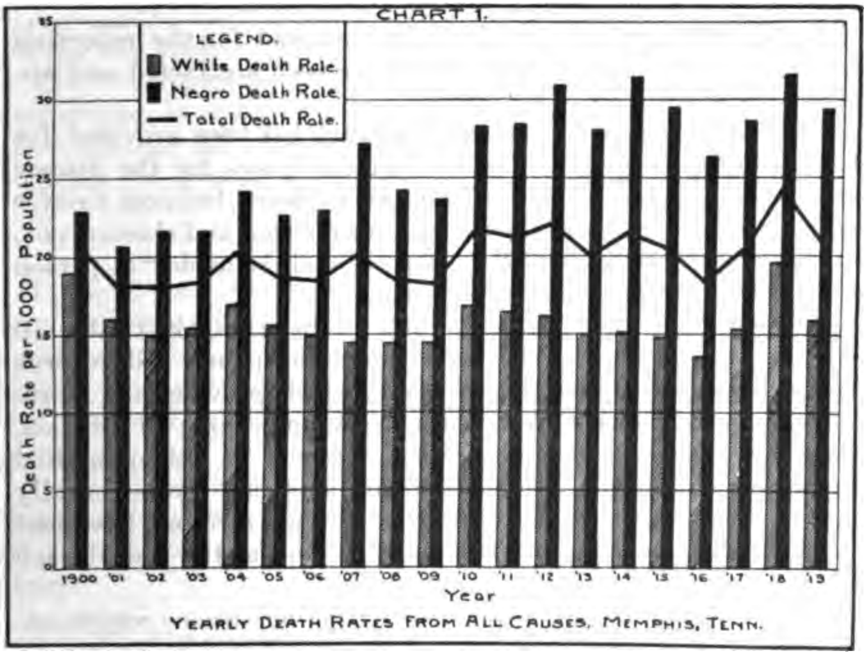
III. Control of Communicable Diseases.

The prevention and control of communicable diseases is considered the most important function of a modern health department.

Many boards of health, even to-day, have been established and are being operated on the theory that the control of communicable diseases depends largely upon successful sanitary regulation of the environment, and for this reason large sums of money and great expenditures of energy have been directed to all sorts of nuisances and conditions of filth as being responsible for the origin and spread of many diseases.

Preventive medicine has pointed out the more vital importance of controlling the individual who is sick or may be infected with any communicable disease. It is the individual, therefore, that becomes the dangerous focus from which disease is spread, and in the measures adopted for the control of communicable disease, activities must be directed toward the individual rather than the environment, and the division of communicable disease, therefore, becomes the most important division in the modern health department.

CHART 1.



YEARLY DEATH RATES FROM ALL CAUSES, MEMPHIS, TENN.

In Memphis at the present time there is no well-defined division for the control of communicable disease. The various activities that ordinarily are associated with such a division will be considered here. This will include morbidity reporting, the duties of the secretary, health officer, contagious-disease inspector, sanitary officer, school nurses, and the diagnostic laboratory.

pression and control of syphilis and gonorrhea constitutes one of the most important problems confronting every city to-day, and that the time has come when the cloak of secrecy and privacy, so long favoring continued spread of these infections, must be thrown aside and the public health aspect of these diseases given proper recognition and action, as well as their so-called "social" or moral relations.

City ordinances adopted July 30 and October 29, 1918, and rules and regulations of the State board of health under date of June 23, 1919, provide for the reporting and control of venereal disease.

There were reported to the city health department during the period of nine months from July 1, 1919, to April 1, 1920, 1,200 cases of venereal disease, as follows: Syphilis, 515; gonorrhea, 526; and chancroid, 159.

The program now being carried on for the suppression and control of venereal diseases has been developed under the direction of a Public Health Service officer in charge of State-wide work in cooperation with the State board of health. These activities have been tied in with and have broadened the work of the venereal disease clinic previously operated in connection with the out-patient department of the University of Tennessee Medical School. From the State allotment of Federal funds there was apportioned to the city of Memphis approximately $3,600 for the fiscal year ending June 30, 1920. A social worker was added to this clinic in December, 1919.

Free night clinic.—Under the direction of the State officer in charge of the division of venereal diseases a free night clinic for men has been established at the out-patient department at the university between the hours of 7 and 11 p. m., and from the State allotment one director of clinics and one male nurse were engaged for part-time service, each at a salary of $100 per month. Cases of syphilis are admitted to the city hospital for the administration of arsphenamine.

Examination of arrested women.—As a far as possible, women arrested by the police are held for examination when there is reason to believe they are infected. On February 1, 1920, the city appointed a chief of the women's protective bureau under the department of police and provided her with office quarters at the central police station and in addition two protective officers and one clerk. This officer had previously come to Memphis in October, 1918, in connection with the law enforcement division of the Committee on Training Camps Activities.

In May, 1919, there was appointed one examining physician, who was placed upon the health department pay roll at a salary of $60 per month, and one health department nurse was assigned to duty at this police clinic. Active examination of suspected women was begun in

June, 1919. These examinations are conducted usually in the forenoon for such suspects as can be held over. Occasionally some of the examinations are made at the night clinic.

Of the 94 women arrested by the police and 19 others brought in from other sources, 32 were examined for venereal diseases, and of this number the diagnosis of positive syphilis was established in 14 and positive gonorrheal infection in 3. Seven of these were sent to the detention home for women, 15 to the workhouse, 7 to the clinic at the out-patient department, and 3 allowed to continue proper treatment with private physicians.

Detention home for women.—A temporary detention home was established in January, 1919, for venereally infected white women. Those who are also drug addicts are placed in the workhouse. The director of clinics and volunteer physicians treat these detained cases. About 150 girls and women have been cared for at this detention home, and because of its physical condition plans are under way for new quarters.

Plans for coming year.—The State officer in charge of venereal disease has submitted to the mayor and health department a plan and budget for the continuance of the venereal-disease work for the fiscal year beginning July 1, 1920. In order to make available to the city its portion of the Federal fund allotted to the State of Tennessee, this budget calls for the appropriation of $5,889 to match an equal sum to be allocated from the State allotment. It is understood that an agreement has been reached to make this budget available.

Because of its important bearing upon the public health the control of venereal diseases should be carried on under the direct supervision of the health department. For this reason it is recommended that there be established in the health department a division of venereal disease as a subdivision of the Bureau of Communicable Disease. The plan of organization and personnel required for such a division should be determined after further conference with the officer in charge of the State division of venereal disease.

TYPHOID FEVER.

In 1919 the city of Memphis had the highest death rate from typhoid fever among 60 large cities in the United States having populations over 100,000. This unenviable rate of 58.4 deaths per 100,000 population was also the highest death rate occurring in any of these large cities since 1911, in which year Memphis again headed the list.

The following table is compiled from data published in the Journal of the American Medical Association on March 6, 1920, and serves to compare the mortality from typhoid fever in a number of southern cities:

TABLE IV.—*Comparison of death rates from typhoid fever of the city of Memphis with other southern cities.*

Cities.	Death rates per 100,000 population.				
	1919	1918	Average 1916–1919.	Average 1911–1915.	Average 1906–1910.
Memphis, Tenn	58.4	15.9	32.6	42.5	35.3
Nashville, Tenn	15.8	32.7	23.5	40.2	61.2
Birmingham, Ala	14.6	31.9	35.8	....	....
New Orleans, La	13.7	20.1	20.0	20.9	35.6
Dallas, Tex	12.2	12.6	17.9	....	....
San Antonio, Tex	9.6	54.3	26.6	29.5	....
Atlanta, Ga	9.6	14.4	14.6	31.4	58.4
Louisville, Ky	9.0	12.4	10.8	19.7	52.7
Richmond, Va	3.7	7.5	10.5	15.7	34.0

Table V is presented to show the monthly distribution of typhoid fever in Memphis for the years 1910 to 1919, and the total deaths for these years.

Chart 3 is based upon the data contained in Table V. These curves indicate graphically the average monthly incidence of typhoid for the 10-year period 1910–1919. In computing these rates, the same population figures used in Table III have been employed, and it is believed that the rates as given in the tables and charts will represent minimum rates.

TABLE V.—*Showing deaths from typhoid fever, by months, 1910–1919, city of Memphis.*

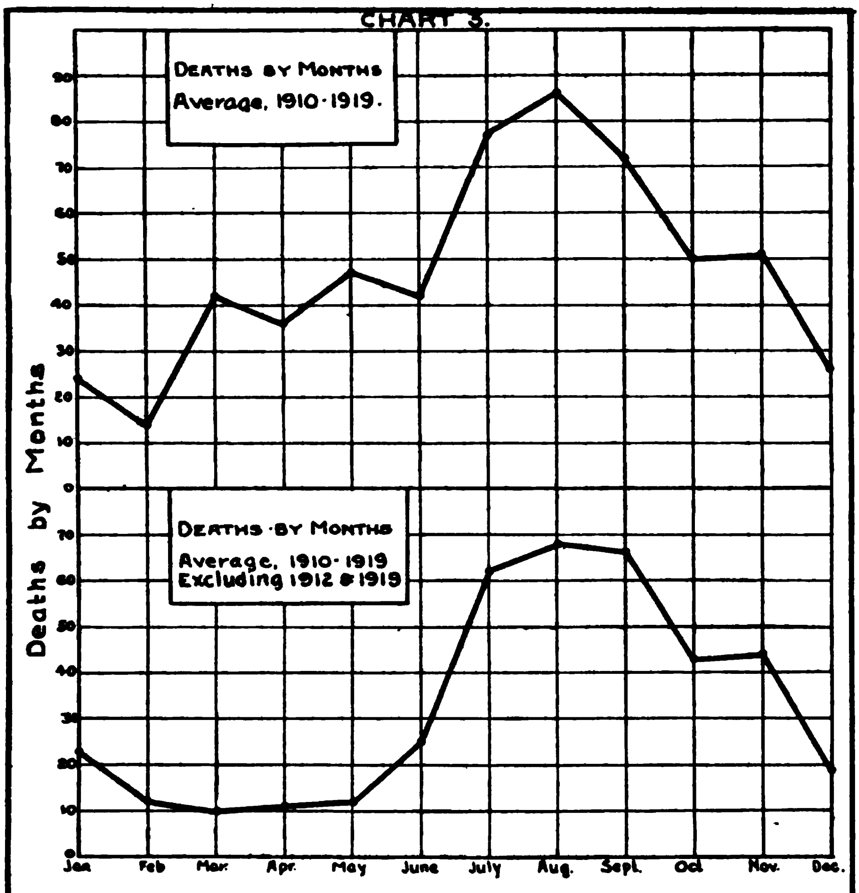
Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1910[1]	2	1	1	1	3	2	3	4	10	7	2	2	38
1911[1]	3	......	2	2	3	2	9	26	20	11	6	3	87
1912[1]	1	......	......	1	25	13	8	11	4	5	6	6	80
1913[1]	2	5	1	1	......	3	8	9	9	4	4	3	49
1914[1]	4	3	4	1	2	6	8	4	6	8	11	4	61
1915[1]	4	3	1	4	1	2	6	5	5	4	4	......	39
1916[1]	3	......	1	2	1	6	19	10	5	3	12	4	66
1917	1	......	......	......	1	3	5	5	7	4	4	2	32
1918	4	......	......	......	1	1	4	5	4	2	1	1	23
1919[1]	......	2	32	24	10	4	7	7	2	2	1	1	92
Total	24	14	42	36	47	42	77	86	72	50	51	26	567

[1] Figures secured from the death certificates (transcripts) on file in office of health department. For 1917 and 1918 the data were taken from the annual reports as published by the health department. It will be found that total deaths and deaths by months do not check with published mortality records of the United States Bureau of the Census. The discrepancies appearing in the annual reports of the health department are unexplained. The totals given here are probably sufficiently accurate for indicating at least roughly the monthly incidence of typhoid fever.

Chart 4 is presented to show the annual death rates from typhoid fever for Memphis for the 20-year period from 1900 to 1919 and for comparison a similar curve for the city of Louisville, Ky., beginning in 1901.

The high peaks for the years 1911, 1912, and 1919 are due to definite epidemics. The relatively lower rates for 1917 and 1918 are encouraging, although the data for these years has not been verified. In the absence of epidemiologic data, the factors responsible for this excessively high mortality from a readily preventable disease can not be definitely determined.

CHART 3.

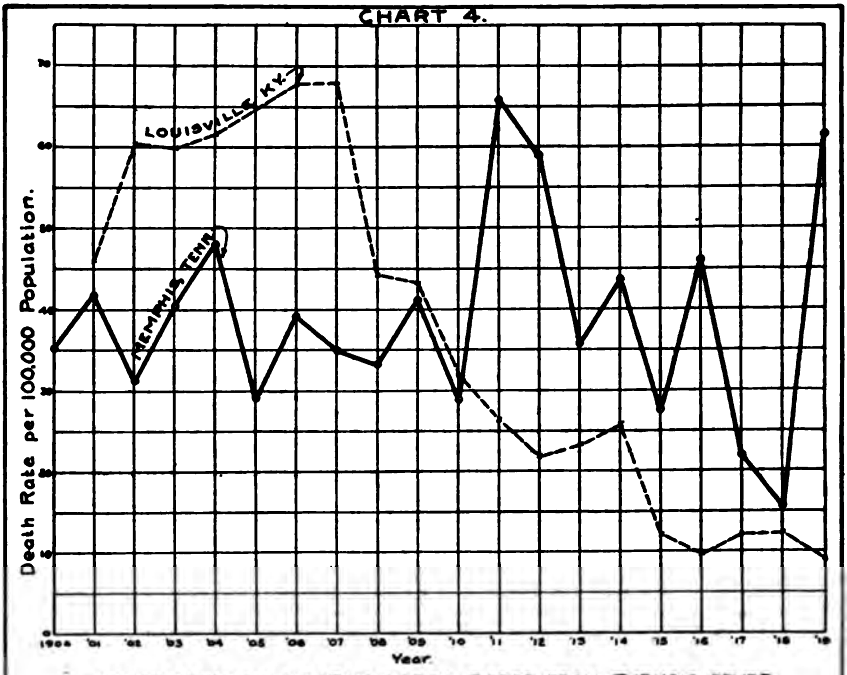


AVERAGE MONTHLY DISTRIBUTION OF DEATHS FROM TYPHOID FEVER
DURING YEARS 1910-1919
CITY OF MEMPHIS, TENN.

Louisville, Ky., represents a city fairly comparable to Memphis. The curves of typhoid mortality for the Kentucky city indicate a much better control over this infection. The decided drop in the curve following the year 1907 was due to the installation of a safe water supply and the extension of the sewerage system.

Chart 5 gives the annual distribution of mortality from typhoid fever in Memphis by color for the 20-year period from 1900 to 1919. The mortality rate among Negroes has exceeded that of the whites with the exception of the years 1900–1903 and 1917. During the epidemic years 1911, 1912, and 1919 this unequal distribution by color is clearly shown in the chart. In attempting to explain the higher incidence among the Negroes, without epidemiologic study, a number of possible contributing factors must be considered, namely, private well supplies, insanitary privies and yard closets, poor housing conditions and environment, and lack of appreciation of the bearing of personal hygiene upon the spread of typhoid fever and similar infections.

CHART 4.



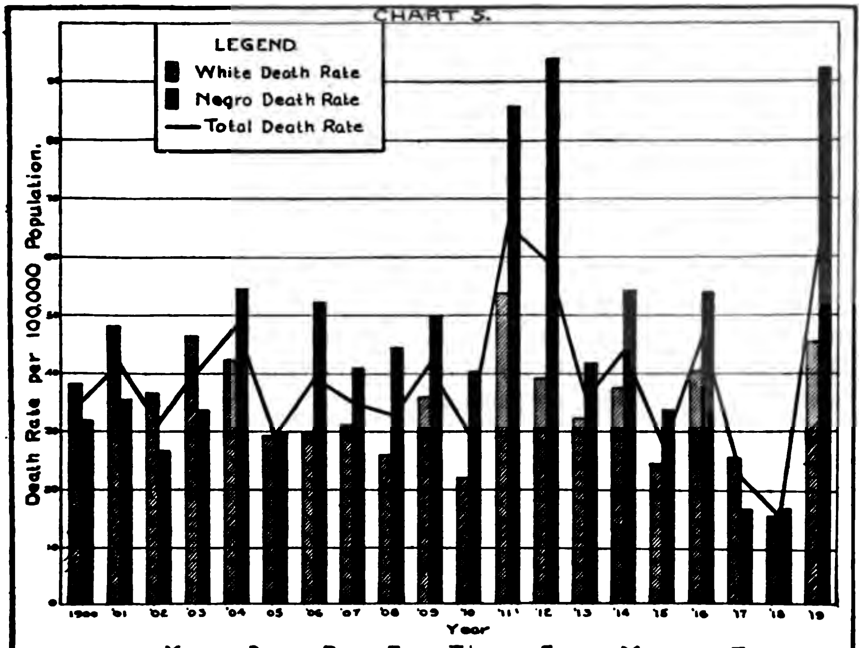
COMPARISON OF YEARLY DEATH RATES FROM TYPHOID FEVER
MEMPHIS, TENN. AND LOUISVILLE, KY.

The high incidence of typhoid fever among the colored population in Memphis has a distinct influence upon its incidence among the white residents because of the distribution of the colored sections and their association with the white families as servants and in other capacities. To reduce the general death rate from this disease it will be necessary to eliminate the factors responsible for its continued high prevalence among Negroes.

Water-borne epidemics.—Although it is generally understood that at least two water-borne epidemics have occurred in Memphis, in 1912 and 1919, there are practically no published records of these epidemics of any epidemiologic value.

1912 epidemic.—In 1912 the Mississippi River overflowed its banks. During the flood stages it is reported that sewer mains were broken, and polluted water found its way into one of the water-supply systems through a broken manhole. Direct pollution of a tunnel collecting water from artesian wells resulted, and 623 cases with 82 deaths are recorded in the annual report of the health department for that year. Table V shows the deaths reported. with the peak of the epidemic occurring in April.

CHART 5.



YEARLY DEATH RATE FROM TYPHOID FEVER; MEMPHIS, TENN.

Efforts were made to limit the epidemic by means of a shut-off system. Sprinkling carts were used to distribute safe drinking water, and the mains later disinfected by means of chloride of lime, using 10 to 20 pounds per million gallons of water pumped. Over 10,000 persons were reported to have been inoculated with antityphoid vaccine.

1919 epidemic.—Early in the year 1919 there occurred a distinct epidemic of typhoid fever, and again the public water supply has been convicted as the cause of an epidemic. No record of the epidemic has been prepared. It is reported that a sewer main broke and raw sewage again entered the tunnel system. The record of the total number of cases resulting from this catastrophe was not available. Table V shows the number of deaths reported and, roughly, the chronology of the epidemic which prevailed during February, March, and April.

Other typhoid epidemics.—In 1911 the annual report for that year records the fact that during the summer "the entire southern section of the country was afflicted with typhoid fever." A total of 623 cases were reported, 538 among the whites and 85 among the colored population. No further comment is made as to the probable cause of this epidemic. It seems very probable, although the evidence is not conclusive, that this epidemic may have resulted from contamination of the city water supply. Bacteriological examinations were taken only at irregular intervals, and there had existed and still exists a feeling of security in the purity of this water supply. Subsequent histories of undoubted water-borne epidemics rather strengthens the opinion that the epidemic of 1911 may very probably have resulted from pollution of the public water supply.

In 1916 a considerable outbreak of typhoid fever was attributed to an infected ice-cream supply. No record of this outbreak appears in the annual reports of the health department. In July of that year the city chemist examined blood specimens from persons employed on a dairy located in Oakville, Shelby County. This dairy supplied about 40 gallons of milk daily to the Memphis Ice Cream Co., the milk being used without pasteurization in the manufacture of ice cream. Of four blood specimens, one gave a strongly positive Widal reaction for typhoid. The girl from whom the specimen had been secured died July 29 of typhoid fever.

The cases occurring during this epidemic were quite generally scattered over the city, and there was reported to have occurred a general increase in the incidence of the disease in the surrounding country. The epidemiologic history as collected by the city chemist points to the ice cream sold by the company mentioned above as a possible source of a number of cases. One hundred and fifty-seven cases had their onset during the month of July.

It is most unfortunate that more complete records of the epidemiology of typhoid fever in Memphis have not been assembled. The distinct epidemics that have occurred, and the high endemic incidence of this disease has deserved more serious consideration than has been given.

Study and control of typhoid.—There is no evidence of any real epidemiologic study of typhoid fever. No spot maps or other valuable aids to such a study have been used.

The number of cases reported during the period 1910 to 1918 is shown in Table VI, compiled from annual reports of the health department. From these data, it is apparent that an average of about 75 per cent of all cases have been reported.

TABLE VI.—*Showing number of cases of typhoid fever reported to health department for the years 1910–1918.*

Years.	Cases reported.	Deaths.	Indicated case fatality.	Years.	Cases reported.	Deaths.	Indicated case fatality.
			Per cent.				*Per cent.*
1910	180	38	21.1	1915	233	39	16.7
1911	627	88	14.0	1916	530	66	12.5
1912	669	80	12.0	1917	248	32	12.9
1913	289	49	16.9	1918	118	23	19.5
1914	436	61	13.9				

The cases reported are placarded by the sanitary officer or contagious disease inspector. Each case is said to be visited by a health department nurse who is supplied with a form card for the collection of epidemiologic data. A similar card is provided for the contagious disease inspector. The information called for on these cards is fairly complete and would serve as the basis of study, but as far as could be determined there has been no use made of such data. These cards are merely filed in current files until the termination of the cases.

The bedside prophylaxis of cases of typhoid fever is apparently left to such directions and instructions as may be given by the attending physician. The nurses do not, as a routine at least, revisit these cases. The contagious dieease inspector provides chloride of lime for some cases for use as a disinfectant of infectious discharges, etc.

It is extremely doubtful if small outbreaks of this disease could be detected on account of the very limited data collected and the absence of the necessary epidemiologic study.

Factors responsible for typhoid fever in Memphis.—A brief description of the public water supply system will be given under a separate heading. Reference has already been made to the epidemics caused by direct gross pollution of the public supply. Without more extensive epidemiologic study, the relation of this factor to typhoid incidence can not be definitely determined.

In addition to the public water supply, circumstantial evidence points strongly to certain other local factors which are very probably vitally concerned in maintaining a high endemic incidence of this disease, namely, numerous private wells, insanitary privies, and so-called "yard closets," excessive fly prevalence, inadequate collection and disposal of garbage and organic filth, and lack of effective control over milk supplies and foodstuffs.

With these conditions in mind, and in the absence of adequate and effective control over actual cases of typhoid fever as dangerous foci of infection for further spread of the disease, it does not seem difficult to understand the excessive prevalence of this disease. Further reference to some of these typhoid factors will be made under subsequent headings.

The control of typhoid fever is one of the problems confronting the health department of this city. The incidence of this disease may be taken as a fairly reliable index of the general sanitary conditions prevailing, and while some of the factors contributing to its high endemic prevalence are at once apparent, a thorough epidemiologic study should be undertaken at once in order to determine those factors most responsible and every effort made then to eliminate or correct these conditions and thus prevent unnecessary sickness and loss of life.

INFANT MORTALITY.

Since 1910 there has occurred a yearly average of 500 deaths among infants and children under 5 years of age, and for the same period 150 infants for each 1,000 births reported have died during their first year. This latter rate, while obviously high because of the fact that all births are not reported, in actual numbers of deaths represents an annual average of over 350 deaths during the first year of life.

Table VII gives the number of stillbirths and premature births reported to the health department since 1910. There is also included the indicated death rates for all causes under 1 year and 5 years, for diarrhea and enteritis under 2 years, and for other causes in early infancy.

While the percentage of deaths in infants under 1 year of age and in children under 5 years compares favorably with other southern cities and is perhaps lower than the average for all registration cities, there is no reason why strenuous efforts should not be made to prevent this unnecessary sacrifice of innocent lives by the inauguration of measures providing for prenatal care of expectant mothers, the care of newborn, and the health and welfare of children during their helpless ages.

TABLE VII.—*Showing deaths under 5 years of age, by color and certain causes.*

Years.	Number of stillbirths reported.			Number of premature births reported.			Deaths exclusive of stillbirths.													
							Death rates per 100,000 population.												Deaths under 1 year per 1,000 births reported.	Per cent total deaths under 5 years.
							Other diseases of early infancy.			Deaths, all causes, under 1 year.			Diarrhea and enteritis under 2 years.			Deaths from all causes under 5 years.				
	Total.	White.	Colored.	Total.	White.	Colored.	Total.	White.	Colored.	Total.	White.	Colored.	Total.	White.	Colored.	Total.	White.	Colored.		
1910	211	52	159	......	......	......	13.7	6.4	25.0	283.2	239.7	355.8	106.9	115.4	96.1	410.6	342.3	521.2	130.7	18.9
1911	......	......	......	......	......	......	5.3	6.2	3.8	270.7	238.8	325.0	100.0	110.0	86.5	422.6	362.5	523.1	132.8	19.8
1912	......	......	......	......	......	......	32.6	32.9	32.1	297.7	231.7	400.0	71.9	57.3	84.9	434.8	292.7	654.7	319.8	19.7
1913	241	85	156	35	14	21	19.7	19.0	20.8	246.7	180.9	350.9	50.4	42.9	62.3	345.3	260.7	479.2	134.9	17.2
1914	184	77	107	......	......	......	35.3	34.9	35.8	230.9	181.4	311.3	71.9	58.1	94.3	330.2	258.1	447.1	150.4	15.4
1915	211	52	159	......	......	......	14.2	11.5	18.9	168.1	150.6	200.0	49.6	48.3	52.8	250.4	224.1	298.1	111.0	12.2
1916	228	79	149	57	27	30	17.5	20.2	12.9	187.4	164.6	225.9	32.8	28.1	40.7	265.7	226.9	329.6	116.8	14.4
1917	205	65	140	73	39	34	44.8	46.2	42.6	237.2	200.0	300.0	42.1	31.9	59.3	386.2	319.8	498.1	145.7	18.9
1918	212	97	115	39	24	15	31.9	30.1	35.2	199.3	178.5	235.2	45.6	45.2	46.3	333.3	286.0	414.8	145.0	13.8

The above table is based upon mortality statistics taken from the annual report of the health department. These records are incomplete, and because of many errors appearing in the annual reports, the rates given will not represent true death rates.

There has been no systematic or continued program adopted and carried on by the health department along lines of infant or child welfare activities. For a few years the Public Health Nursing Association has undertaken independently a limited amount of infant welfare work during summer months, as shown in the following summary of its activities:

Summary of prenatal and infant welfare work (July, August, September, 1919), Public Health Nursing Association.

Prenatal:	
Number of visits to houses	623
Number of clinics attended	11
Number of deliveries attended	12
Prenatal cases under care Jan. 1, 1920	58
Pregnancies, dismissed to hospitals, etc., for confinement	130
Assistance given:	
Doctors sent	60
Hospital care secured for	113
Prescriptions filled	97
Ambulance sent	43
Infant welfare:	
Baby conferences held with baby specialists in attendance	16
Attendance at conferences	82
Number of babies visited in homes	130
Number of infant welfare visits	985
Instructive visits in care and preparation of food	269
Diseases of early infancy and malformations	141
Care of new born	159

Milk stations.—During the past two years the nurses of the health department have operated eight milk stations during one or more months in summer. These stations have been financed by the Memphis Press, and milk has been supplied to babies without charge. The stations are open from 9 a. m. to noon daily, babies are weighed, and general advice is given to the mothers. In the afternoon the nurses visit the homes for follow-up work. It was stated that from 30 to 200 babies have attended each milk station.

Coordination of activities.—There has been a decided lack of coordination between the health department and other agencies concerning themselves with infant welfare as well as other public health activities. In reorganizing and developing these activities, the full support and cooperation of all nonofficial organizations should be sought and the administration and direction of all prenatal and child welfare activities undertaken in Memphis should be centered in the health department in order to make possible a systematic and comprehensive program.

DEATHS FROM PREVENTABLE DISEASES.

Approximately 40 per cent of the deaths occurring each year are the result of diseases that are usually classed as preventable, as shown by Table VIII. If to this group there are added deaths from "external causes," including homicides and those resulting from other forms of violence, the proportion of preventable deaths will usually exceed 50 per cent of the deaths from all causes.

With an adequate division of communicable diseases it should be possible to markedly reduce this unnecessary loss of human lives every year. Special attention should be given to typhoid fever, the common diseases of childhood, pulmonary tuberculosis, the pneumonias, and the various causes of infant mortality.

TABLE VIII.—*Showing deaths from certain preventable causes, for the years 1910–1918, city of Memphis.*

Diseases.	1910	1911	1912	1913	1914	1915	1916	1917	1918	Total.
Typhoid fever	38	87	80	49	61	39	66	32	23	475
Malaria	102	119	108	90	79	96	60	45	44	743
Smallpox	......	1	......	......	......	......	......	......	......	1
Measles	1	9	1	4	6	1	......	15	4	41
Scarlet fever	7	3	1	12	2	5	6	4	2	42
Whooping cough	4	19	6	13	10	......	1	11	8	72
Diphtheria and croup	13	22	10	17	20	18	17	23	12	152
Influenza (grippe)	34	27	35	20	18	25	20	15	172	366
Dysentery	19	18	22	7	11	16	22	19	18	152
Septicemia	54	47	43	39	50	43	52	59	52	439
Tetanus	9	7	9	13	4	5	10	9	3	69
Pellagra	5	14	26	37	106	99	45	39	32	403
Tuberculosis (all forms)	351	325	349	335	434	416	390	409	407	3,416
Syphilis	7	23	24	15	33	28	31	22	29	212
Gonococcus infections	......	1	......	1	......	......	......	......	......	2
Cerebrospinal meningitis	17	13	37	50	15	2	2	16	11	163
Bronchitis	36	39	35	24	19	16	16	24	26	235
Pneumonia (all forms)	265	280	261	246	260	247	177	350	824	2,910
Diarrhea and enteritis:										
Under 2 years	140	133	97	69	100	70	47	61	67	784
Over 2 years	21	39	39	31	40	41	19	28	36	294
Total deaths, all causes	2,818	2,833	2,979	2,758	2,989	2,900	2,648	2,958	3,563	......
Deaths from preventable causes	1,123	1,226	1,188	1,072	1,268	1,167	981	1,181	1,770	......
Per cent	39.9	43.3	39.7	38.8	35.7	40.2	37.1	39.9	49.7	......

With the exception of the deaths from typhoid fever the figures in the above table were taken from annual reports of the health department.

EPIDEMIOLOGIC STUDY.

When cases of communicable diseases are fairly completely reported to the local health department and adequate records, tabulations, and spot maps are prepared and carefully and consistently studied, the health department is at all times in a position to know quite accurately the incidence and geographic distribution of the prevalent infections. Excessive endemic prevalence and mild outbreaks of communicable diseases will be detected.

This so-called epidemiologic study is a most important activity and it requires special training and practical experience. Successful control of communicable diseases depends upon the carrying out of such measures as may be decided upon after a careful study of the epidemiologic data assembled. Any other method or attempt to control any communicable disease is haphazard, unscientific, and expensive, because much time and energy will be wasted, and the main factors responsible for the spread of a disease may be entirely overlooked.

As far as could be determined, there has been in Memphis very little attempt to conduct any epidemiologic studies of even the more prevalent diseases. Although a certain amount of data is collected on forms provided for such diseases as typhoid fever and tuberculosis, no practical use is made of this information. In the proposed reorganization of activities the activities of the division of communicable diseases must be carefully and thoroughly developed.

HEALTH ACTIVITIES OF NONOFFICIAL ORGANIZATIONS.

Reference has already been made to the financial aid extended by the city to the associated charities and the Public Health Nursing Association. These grants, if maintained at a similar scale in 1920, will amount to about $12,000. This sum is charged against the health department expenditures, and it is intended largely to relieve the city of further obligations concerned with the care of the indigent. The city exercises no supervision over the expenditure of these allotments, and while there is undoubtedly much good accomplished, it does not seem to constitute a good business policy on the part of the city government, and surely should not be made a charge against the health department budget.

While some of these nonofficial organizations are not concerned directly with public-health activities, a part of the work carried on by the Public Health Nursing Association is closely allied to the functions belonging to a municipal health department, and the Shelby County Tuberculosis Association concerns itself solely with the problem of tuberculosis.

The following report of the Public Health Nursing Association for the year 1919 indicates the activities and scope of work carried on by this organization. In addition to the officers and one director of nurses, there are employed four white and five colored nurses in the field and one nurse for office work.

Summary of report of Public Health Nursing Association, 1919 (exclusive of prenatal and infant welfare work).

Number of patients brought forward	97
Number of new patients	4,437
Number of patients still under care at end of year	364
Patients classified:	Patients.
Associated charities, 7,280 visits	1,389
Metropolitan Life Insurance Co., 12,950 visits	2,848
Home Service Section, American Red Cross, 248 visits	47
Western union	22

Patients classified—Continued.	Patients.
Pay service	12
Other	119
Clinic and other visits, 260.	
Absent, no illness, or not found, 240 visits.	
Diagnosis of dismissed cases:	
Typhoid fever	123
Influenza and la grippe	911
Malaria	99
Tuberculosis of lungs (positive)	71
Tuberculosis, other forms	11
Pellagra	13
Other general diseases	224
Cancer	25
Nervous system and organs of special sense	110
Circulatory system	69
Respiratory system, pneumonia, bronchitis, etc	318
Digestive system, diarrhea and enteritis	176
Other diseases	257
Genito-urinary system and adnexa	220
Puerperal state, puerperium	248
Other diseases	51
Skin and cellular tissue	44
Bones and organs of locomotion	5
Old age and senility	25
Affections produced by external causes	277
Not found	119
Ill-defined or undiagnosed	341
Classification of dismissed cases:	
Condition on discharge—	
Cured or improved	3,462
Unimproved	425
Dead	164
No illness, not found	119
Color and sex—	
White—	
Female	1,386
Male	651
Colored—	
Female	1,548
Male	466
Unknown	119
Discharged to—	
Dispensary	211
Hospital	188
Others	352
Family	3,124
Unknown	131

There should be developed and fostered a closer alliance between the health department and the several private organizations in order to bring about a uniform and consistent program of all public health activities and to utilize to best advantage all resources available for health work.

IV. HEALTH SUPERVISION OF SCHOOL CHILDREN.

The provision of a medical service for the physical examination of school children and the direct control of preventable communicable diseases in schools and for the remedial care and correction of certain physical defects which otherwise are so frequently neglected through ignorance, intention, or lack of financial resources should form a part of the public health program of every community.

MEDICAL INSPECTION OF SCHOOLS.

From 1908 to 1916 a force of part-time physicians was employed for the medical inspection of school children. In 1914 17 physicians and 4 nurses were engaged in this work. The medical force was reduced to 1 part-time physician with 12 nurses in 1917.

How valuable this service may have been can not be determined from the records and published reports. For example, in 1914 there were 18 physicians acting as medical inspectors, 4 out of a total of 34 schools were visited, and 6,073 physical examinations made out of a school enrollment of about 20,000 pupils.

In 1918 the following summary from the report of the chief school inspector, as published in the annual report of the health department for the year, indicates the general activities of this division, with a personnel of 1 medical inspector and 14 nurses:

Summary report of medical inspection of schools (1918).

Physical examinations made	13,967
Cultures taken	946
Vaccinations made	24
Rooms fumigated	16
Pupils readmitted	5,721
Pupils excluded:	
Communicable diseases	2,237
Cases not diagnosed	690
Exposure to contagious diseases	333
Excluded for vaccinations	1,521
Diseases or defects requiring treatment:	
Hypertrophied tonsils	3,446
Adenoids	1,168
Nasal catarrh	40
Malaria	82
Defective vision	390
Defective hearing	112
Defective speech	58
Defective teeth	4,826
Skin affections	94
Orthopedic	24
Backward children	52
Miscellaneous	3,263

Defects corrected:

Adenoids	190
Tonsils	215
Eyes, operations and treatments	33
Glasses fitted	28
Teeth filled	1,240
Ears treated	18
Ear operations	3
Miscellaneous	15

Although this report appears under the caption of "Medical inspection of schools," it was learned that it represented largely the activities of the health department nurses. The "physical examinations" were made usually by the nurses, and many of the pupils excluded because of communicable diseases were excluded as a result of notifications sent to the schools after reports of cases had been received by the health department.

PRESENT SCHOOL INSPECTION SERVICE.

At present there is no medical personnel engaged primarily for the health supervision of school children, the chief school inspector having been discontinued on March 1, 1920. There are on duty in the health department 18 nurses under the direction of one supervisor of nurses. Sixteen nurses are assigned to school work during the school year.

As the duties of these nurses are largely concerned with work in the schools for about 9 months of each year, the activities of the nursing corps will be considered here, previous mention having been made of their duties as public health nurses in connection with the general control of communicable diseases.

ACTIVITIES OF SCHOOL NURSES.

There is at present an enrollment of about 25,000 school children in 34 public schools. Each of the 16 nurses, including 4 colored nurses, are assigned to from 2 to 4 schools, giving each nurse supervision over approximately 1,500 pupils. They are on duty at the schools from 9 a. m. to 3 p. m. daily during the school year.

The routine work at the schools is as follows: Daily visits are made to all public and private schools in accordance to a daily schedule. Each room is inspected in turn and a short talk given to three rooms daily on personal hygiene, ventilation, and special health topics. Absentees returned to school are individually inspected. Swabs and temperatures are taken in suspicious cases of illness. This requires about one hour in each school. During these room inspections excludable conditions are noted and immediate action taken. Nonexcludable conditions are also noted and a printed slip filled out for such defects or physical conditions as require special expert attention, this slip to be taken home to the parent and a copy of each notice retained by the nurse. Reports received by the school authorities or nurses giving names of school children coming from residences from which communicable diseases have been reported to the health department are acted upon and the children excluded if found in school.

Once during the school year each child is "examined" by a nurse and the findings recorded on a "physical record" card, which is filed at the school and follows the pupil through the eighth grade. This card gives a brief history of the occurrence of the more common infectious diseases and very briefly the results of the examinations made by the nurse, particularly as to defects in vision, hearing, breathing, tonsils, teeth, etc., and a record of height, weight, and mentality. Each nurse examines on an average about 20 pupils daily.

A printed form is provided for notification of the parents of such defects as require attention, and after 3 p. m. daily and during the summer, pupils with correctable defects are followed up to encourage and to arrange for remedial care.

Absentees that can not be accounted for are visited after school hours. There is obviously but little time left for this follow-up work during the school year.

Glasses have been provided for indigent pupils through a special fund made available by the Kings Daughters' Circle, and some dental attention has been secured for children at the fresh-air school.

The health department nurses wear no uniform and are not provided with nurses' bags. They have practically no literature for distribution. For field work they are allowed actual expense of transportation on street cars.

A "round table" talk is held by the supervisor of nurses once each week. Special papers are prepared by the nurses and from time to time a speaker is secured to address them on subjects of special interest. Each nurse keeps a daily record of work performed and submits a monthly report of all activities.

Parent-teachers associations hold monthly meetings at nearly all of the schools. Through these associations about 15 lunch rooms are operated.

SCHOOL SURVEY.

A survey of the public-school system of Memphis was made in 1919 by the Bureau of Education, Department of the Interior. The report of this survey[2] indicates that "approximately two-thirds of them (school children) are 'normal' in the sense that they are free from defects and disabilities that will permanently handicap them or impede their growth or development." This report further states that "there are no records of the physical condition of the children in the Memphis public schools."

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[2] The Public School System of Memphis, Tenn., Bulletin, 1919, No. 50, pt. 7, Health Work. Department of the Interior, Bureau of Education. Government Printing Office, 1920.

SCOPE AND REQUIREMENTS OF SCHOOL MEDICAL INSPECTION.

In order to properly promote the health of school children, provisions should be made for maintaining thorough sanitation of all school buildings and the necessary supervision over all classrooms in order to prevent conditions injurious to health; full-time medical inspectors qualified to carry out the necessary sanitary and medical supervision; full-time school nurses; ample facilities for dental inspection; gratuitous treatment, when necessary, for conditions that otherwise would be neglected; and thorough mental examinations of pupils who fail to show normal progress in their educational development.

The medical inspection of schools should constitute an activity functioning with and under the direct supervision and direction of the health department, as a division of its organization. Its scope of operations should include examinations for physical or mental defects, including dentition, hearing, vision, posture, and other abnormalities which influence physical or mental development. Parents should be notified of such defects or conditions as require remedial attention and encouraged to secure the necessary treatment.

Thorough medical and physical examinations should be made of all children upon entrance to schools and the findings noted on a suitable blank form which should be properly indexed and follow the pupil through the grades. Subsequent examinations will frequently be necessary, and the results should be entered on the physical records.

The medical inspector or school physician should devote his full time to his official duties and be qualified by training and experience to perform this important public function. The school nurse should be directly responsible to the school physician. In addition to assisting him in the schools, she should visit the parents of children excluded or absent on account of sickness or other condition and as a public health nurse instruct them in measures for the care of sick and prevention of disease. She should follow up all cases recommended for treatment and arrange if necessary for proper attention. Visits should also be made to the homes of pupils absent longer than three days for unknown causes in order to ascertain the reasons for absence and the possible existence of communicable diseases. When the school year has closed the school nurse should be assigned to infant welfare work or some public health nursing activity.

In the health supervision of school children there is a line of cleavage between functions that are medical and those that are purely educational, and hence incumbent upon the educational authorities. A department of school hygiene is becoming recognized as an important division of our educational system. Many of the disabilities of heredity or neglect can be readily detected and many of these deficiencies can often be corrected by proper instruction and training. Such activities as are purely medical or aimed at supervision over the health of the child, including measures for the control of communicable diseases, should be placed under the direct authority of the health department.

To place the entire responsibility for all activities required for adequate supervision of the health of school children in Memphis under the administration of the health department would necessitate a considerable increase in the present personnel and budget. The recommendations that will be made for the development of a bureau of medical inspection of schools to meet present requirements and conditions will therefore be conditioned upon the establishment of a department of school hygiene under the board of education.

V. Chemical and Bacteriological Laboratory.

Reference has already been made to the diagnostic work carried on by the health department laboratory. In addition to this function, there must be considered the other activities undertaken under the direction of the city chemist. These include the enforcement of the pure-food laws, control over the production and handling of milk and other foodstuffs, the preparation of narcotic solutions for the antinarcotic dispensary, and bacteriological examinations of drinking water.

PERSONNEL AND EQUIPMENT.

The position of city chemist is provided for by ordinance, and his salary is fixed at $2,400 per annum. The present incumbent has held this position since 1914. In addition to assuming charge of the laboratory he has direct supervision over the milk and meat inspectors.

There are at present on duty in the laboratory one assistant or technician, one clerk whose salary is paid out of receipts for the sale of narcotics, and one colored maid, who cleans glassware, acts as messenger, and performs other similar duties.

The laboratory occupies two fair-sized rooms, and the present equipment is reasonably adequate for the character and amount of work undertaken. When new quarters are provided for the health department, occasion should be taken to renew part of the old equipment and to purchase some more modern apparatus in order to extend the facilities for diagnostic work.

Laboratory records are not as complete and satisfactory as they should be, in some instances only the rough bench sheets being filed for future reference.

On the whole the laboratory division shows more competent and conscientious management than other divisions of the health department. Too many functions, however, have been imposed upon the director of the laboratory.

ENFORCEMENT OF PURE FOOD ORDINANCE.

The enforcement of the pure food ordinance is placed under the supervision of the city chemist. Samples of various foodstuffs collected by the milk, meat, and food inspectors are examined by the city chemist for misbranding and tested for adulteration and wholesomeness.

The pure food ordinance in force March 24, 1908, is fairly comprehensive. The essential provisions have been abstracted and will appear in the appendix.

In 1918, 2,110 miscellaneous samples of various foods and beverages were examined. A considerable number of violations of the ordinance are found each year and the majority of these offenders are fined by the courts.

BACTERIOLOGICAL EXAMINATIONS OF WATER SUPPLIES.

Prior to the typhoid epidemic of 1919, bacteriological examinations had been made of the city water supply on an average of once or twice each week. Although the results of these examinations have not been published by the health department, the total bacterial counts on agar after incubation at 37° C. have been very low, probably not over 4 per cubic centimeter, and it is reported that gas was never found in lactose bouillon fermentation media in 1 cubic centimeter samples.

Subsequent to the 1919 epidemic, daily (six times each week) examinations of two samples of the public water supply have been made at the health department laboratory. As a routine, only the total bacterial count on agar is undertaken, as "*B. coli* is never found in 1 cubic centimeter samples." The total counts have varied from zero to four or five for each sample. This is the only bacteriological control maintained over the city water supplies. A daily report of the findings is given to the water department.

Further discussion of this subject will be found under the section dealing with water supplies.

Occasionally, bacteriological examinations of samples of water from private water supplies are made, and in the past a number of polluted sources have been abandoned.

ANTINARCOTIC DISPENSARY.

In October, 1919, an antinarcotic dispensary was established at the police station in order to attempt a better control over drug addicts and "boot-legging." A physician on part-time service is employed and his salary—$50 per month—is paid out of the receipts for the sale of narcotics. A social worker is also on duty, her salary also paid from this fund.

Morphine sulphate, in sterile solution, is prepared in the health department laboratory and dispensed in small vials by the physician in charge of the dispensary. A charge of 5 cents per grain of the drug is collected and deposited with the city chemist, who is charged with the accounting and expenditure of this fund. About 26,000 grains of morphine sulphate have been sold in this way each month.

The preparation of solutions, washing and sterilizing glassware, dispensing, and accounting have occupied considerable time and under present conditions, with inadequate personnel, distracts the laboratory from more important activities. If this so-called "antinarcotic dispensary" is continued, it should be divorced from the health department or ample provision made for its continuance. It might preferably be conducted as a branch service at the city hospital.

VI. Control of Food Supplies.

Although meat and food inspection is conducted under the direct supervision of the city chemist, as required by city ordinance, these activities will be considered separately.

The city "meat inspector" receives a salary of $125 and an allowance of $3 per month for transportation. He "inspects" all meat products shipped into the city and collects a "fee" of $2 per carload shipment from the consignees. These products have previously passed inspection and bear the Government stamp. This so-called inspection seems to be a more or less perfunctory activity, and to secure the full salary of $1,500 per annum it is necessary to collect at least that amount in fees. From $200 to $300 is collected each month and deposited with the city treasury.

The "city meat inspector" also inspects domestic meat products, affixes the official stamp, and collects certain fixed fees.

One additional meat inspector is employed. He is on duty each morning at the market house, where he inspects and stamps most of the meat product slaughtered locally because of the fact that no fee is charged for his services. In the afternoon he visits local abattoirs and slaughterhouses.

In 1918, 14,796,645 pounds of cold storage and 2,638,251 pounds of domestic meats and meat products were inspected and a total of 601,488 pounds condemned and destroyed. There is evidently need for continual supervision over the quality of these products offered for sale.

As will be indicated later, the city chemist should be relieved of the supervision over this division of health department functions and meat inspection placed in a newly organized division.

CONTROL OF FOOD-HANDLING ESTABLISHMENTS.

Three food inspectors, under the direction of the city chemist, are employed for the inspection and control of eating places and food-handling establishments. The city is divided into three districts, north, center, and south, and one inspector is detailed to each district. These inspectors are paid salaries of $100 per month, and in addition allowed from $3 to $4 each month for street car fares.

In the central district a female inspector is assigned, and particular attention is given to places where women and girls are employed.

Daily inspections are made of all groceries, markets, bakeries, eating places, and all establishments where food is prepared or handled. Daily reports of these inspections are turned in to the city chemist.

In 1918, 37,961 "inspections" were made by the three inspectors, and while it was stated that it had been possible to bring about considerable improvement in the sanitary condition of food-handling establishments, personal vists to many of these places indicates that much remains to be accomplished.

SODA FOUNTAINS.

The majority of the soda fountains and soft-drink stores are operating with inadequate facilities for the sterilization of glassware and other eating utensils, and individual service with paper cups is the exception rather than the rule. In many of these places there is really no sterilization attempted, the glasses, spoons, etc., being merely rinsed more or less effectively, very often in cold running water.

EATING PLACES.

There was little evidence of health department supervision over the operations of eating places in general, and many of the smaller lower-grade restaurants appeared rather dirty, dingy, and smelly, with inadequate facilities for the proper sterilization of eating utensils.

SIDEWALK DISPLAYS.

Fruits and vegetables are openly exposed on sidewalks and in many booths and stands, although the city ordinances prohibit these sidewalk displays unless the foodstuffs are "perfectly protected by a suitable covering as authorized by the board of health." Strawberries and other foods were found directly on the sidewalk and readily accessible to the nuisances so commonly committed by stray dogs. Nowhere was any real attempt made to protect these displays from street dust and dirt or from promiscuous handling.

Any statement to the effect that such an exposure of fruits and other foodstuffs constitutes a definite health menace or that it contributes in some measure at least to the spread of disease might be challenged. The practice is surely unsightly and can not be considered a desirable method of handling foodstuffs. That it is unnecessary is shown by a brief survey of Mississippi cities where sidewalk displays are prohibited by State regulation without apparently working any hardships upon the vendors or the public.

In the general clean-up of this practice of street vending there should be included the sale of tamales, wienerwursts, ice cream, candy, cracked pecans, and other wares usually sold from small pushcarts or stands. The personal cleanliness and hygiene of the dispensers of these articles of food, methods of handling, and the sanitary conditions usually existing at the places where they are prepared are sufficient arguments to condemn the practice.

SANITARY CONTROL TO BE EXTENDED.

The present personnel and methods are inadequate to properly control and supervise the sanitary operation of public eating places and the preparation and handling of foodstuffs in general. The development of a system of grading or scoring these establishments and utilizing these ratings as a stimulus to encourage further improvements would undoubtedly bring about better sanitary conditions and more acceptable methods of preparation and handling. Publication of the grades or scores in the daily press not only informs the general public of the relative status of these establishments, but reacts favorably upon the dealers maintaining the higher grades.

Provision should be made for some sort of supervision over the health of those employed in food establishments in order to eliminate those suffering from communicable diseases. The physical condition of employees should be considered in establishing the grades or scores given.

VII. CONTROL OF MILK SUPPLIES.

Supervision over all milk and milk products is also placed under the direction of the city chemist. Routine measures are carried on under two divisions, known as dairy inspection and milk inspection. There is at present one dairy and one milk inspector. A veterinarian was employed until October, 1919, at a salary of $125 per month, and it is expected to fill this position in the near future.

Ordinances regulating the handling and sale of milk within the city were revised in 1918 and in general provide for rather satisfactory control by the health department. An abstract of these ordinances is given in the appendix.

DAIRY INSPECTION.

One dairy inspector is employed at a monthly salary of $100. He is provided with a two-passenger automobile and given police power. He is in reality a part-time employee, being engaged in private enterprise and having had no previous training or experience in dairy inspection.

Frequent inspections are made of all producing dairies within a radius of from 15 to 20 miles in the States of Tennessee and Mississippi. On January 1, 1920, 320 dairies were listed, and about 275 of these are visited by the local inspector.

The dairy inspector also visits the local milk depots and pasteurizing plants. In these inspections there is no attempt to rule with an arbitrary power except after repeated violations or willful contempt for the requirements of the ordinances. It has required constant watchfulness, however, to keep some of the dealers within reasonable bounds.

The following summary of work performed in 1918 gives an indication of the general activities of this division:

Dairy inspections, 1918.

Dairies listed	234
Dairies inspected	2, 591
City milk rooms inspected	43
Notices sent to make sanitary improvements	29
Dairies temporarily excluded account insanitary conditions	1
Permits revoked	3
Dairies quarantined account of anthrax on premises	4
Dairies quarantined account of diphtheria on premises	1
New cow barns	5
New milk houses	6
New wells	2
Number of head tuberculin tested	1, 521
Number of reactors	66
Number of cattle testing suspicious	28

Number of reactors on retest	1
Retest of suspicious reactor (healthy)	1
Dairymen interviewed on improving dairies	209
Milk samples from 5 herds	50
Number of cows excluded from herds	74
Persons from 54 retail dairies vaccinated against typhoid	241

The tuberculin test.—The principal duty of the veterinarian is the tuberculin testing of the herds producing milk sold in the city. The testing of cattle for tuberculosis is also being carried on by a representative of the Bureau of Animal Industry, United States Department of Agriculture. Attention has been given for a number of years to the elimination of tuberculosis from milch cows in this section. During the four years 1915–1918, 9,454 cows were tested and approximately 4 per cent were found to be "reactors." The city ordinance requires that all milch cows be tuberculin tested at least once in each 12 months, and this has apparently been fairly effectively enforced.

Sources of supply.—With the exception of the supply handled by the largest distributor, most of the milk sold in Memphis is produced within a radius of about 20 miles of the city. Milk is shipped in from various points in Arkansas and Illinois, and the bulk of this milk is said to be pasteurized before shipment. There is practically no direct control of this production by the local authorities and no record of the total quantity sold in the city or the amounts produced at the various dairies.

Permits and scores.—Every dealer who sells milk for distribution in the city is required to file an application with the health department, giving certain general information concerning the dairy and the herd. Before a permit is issued an inspection is made by the dairy inspector, who scores the dairies, and if satisfactory and approved by him a permit for a period of one year is issued by the superintendent of health, countersigned by the city chemist.

The scores given are based upon the inspector's judgment of conditions found, the relative weights of the several factors considered having been fixed in accordance with a system devised by the city chemist. About 75 per cent of the dairies scored have been rated at 70 or above. Each dairy among those visited by the local inspector is rated usually once each month, and the inspection and rating of from 8 to 10 dairies constitutes an average day's work.

A daily report on a printed form is rendered to the city chemist, who keeps an "office record" of each dairy, showing sanitary conditions and scores and the results of bacteriological and chemical examinations made. A written notice is served when violations of ordinances are found and not immediately corrected.

When a case of a communicable disease occurs on a dairy, the county authorities are said to promptly notify the city health department, and at the same time to take the necessary steps to safeguard the milk produced at such a dairy. The city dairy inspector also visits the dairy and satisfies himself that there is no risk of infecting the milk sold or discontinues its sale.

MILK INSPECTION.

One "milk inspector" is employed at a salary of $100 per month, and he is provided with a roadster and its upkeep and given police authority. His principal activity is the collection of samples of milk and milk products from delivery wagons. It was stated that an average of 10 samples were collected daily for laboratory examination. Samples for butter-fat determinations are taken in half-pint bottles, which are sealed immediately after collection by passing a wire through the cork and the neck of the bottle, the ends being sealed with lead, the seal bearing an identification number. One of the samples so collected is given to the driver if he so desires it.

In the summer months samples are collected from the wagons for bacteriological examination. For this purpose 15 cubic centimeters of milk are collected with a sterile pipette and placed in a sterile bottle. A refrigerated compartment carrying case is used to store these samples until they reach the laboratory.

LABORATORY EXAMINATIONS.

In addition to the examination of samples of milk, cream, and other milk products for fats and other solids, bacteriological examinations of about 10 samples are made daily during the summer months. Because of the prosecutions secured as a result of these examinations, the average bacterial content of the city supply has been considerably reduced. In 1919 there were 119 prosecutions for various violations of the milk ordinance and $2,215 assessed in fines.

In 1919 the average bacterial count of all samples examined was slightly over 500,000 bacteria per cubic centimeter. Exceptionally high counts are at once investigated by the dairy inspector in order to correct faulty methods of production or handling.

In 1918 the results of these examinations were posted on a bulletin board at the laboratory and the press published the total counts, but refused to include the names of the producers. This publicity has not been attempted since that year, although the milk ordinance provides that the names, scores, and other data concerning each dealer shall be published each month in the daily newspapers.

GRADES OF MILK ESTABLISHED.

The milk ordinance provides for the following grades of milk: Certified; grade A, raw and pasteurized; grade B, raw and pasteurized. The requirements of these grades are indicated in the appendix.

With the exception of about 175 gallons of raw milk sold as "certified" milk, all milk sold in the city is rated as grade B milk. To meet the requirements of grade A would necessitate the installation of facilities for steam sterilization of all utensils, a sanitary score of at least 70 for the raw and 90 for pasteurized products, clarification, and a maximum bacterial count of not over 100,000 bacteria per cubic centimeter at time of delivery. It would be difficult if not impossible at present for many of the grade B supplies to meet these requirements, and dealers are satisfied to be rated at the lower grade.

"CERTIFIED" MILK.

The term "certified," as applied to milk, was adopted by the American Association of Medical Milk Commissions and certain standards and methods[8] for the production and distribution of certified milk were agreed upon and published for the guidance of local medical milk commissions.

Certified milk is designed to meet the requirements of a safe, pure raw milk, suitable for infant feeding. In accordance with the standards referred to, this milk must be "certified" by a medical milk commission appointed by a representative medical society. The local commission is required to provide for the necessary control and supervision over (1) the hygiene of the dairy as it relates to the production and distribution of the milk; (2) the veterinary supervision of the herd; (3) the medical supervision of the employees; and (4) the chemical and bacteriological examinations of the milk. After careful investigation by the commission, a written agreement is entered into with the dairyman desiring to produce certified milk. He is then authorized and required to label his product as "certified," giving the name of the medical milk commission so certifying and the day or date the milk was produced.

The standards and requirements adopted by the American Association are necessarily rigid and comprehensive, and local medical milk commissions must accept these standards as minimum requirements.

The Lem Banks "Certified" Dairy.—About six years ago the medical milk commission created by the Shelby County Medical Society "certified" the plant known as the Lem Banks Dairy. This dairy is located at Raines, Tenn., about 10 miles from Memphis. The standards of the American Association of Medical Milk Commissioners were adopted, and for the first time in this city milk of a "certified" quality was available. This milk is distributed by the Clover Farm Dairy and retails at present for 25 cents per quart.

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[8] Methods and Standards for the Production and Distribution of "Certified Milk." Adopted by the American Association of Medical Milk Commissions, May 1, 1912, Reprint No. 85, Public Health Reports, 1912.

During the present survey a visit to this dairy was made by the writer in company with the dairy inspector. The following comment is made without attempting to give any detailed description of the conditions found. From observations made and information secured from the resident manager of this dairy, it is evident that nearly all of the important standards and methods of certified milk production are honored largely in the breach, and various excuses were offered by the manager for the faulty conditions found at the time of the visit.

Among some of the grosser violations of the standard requirements there may be noted the following: Manure was being stored directly outside the stable; feed was kept in small partitioned rooms at the end of the stable; milking clothes are not provided and have not been used for some time; the dairy building or milk house is directly connected with the stable.

It was learned that in order to augment the present daily production of about 150 gallons an average of 30 gallons was received from a near-by dairy and dispensed under the same label as "certified" milk. The entire output of this other producer is handled by the Banks Dairy, that not labeled as certified being hauled to the Clover Farm plant for pasteurization.

No provisions have been made for supervision over the medical examinations of employees; in fact, any special attempt at regulation has only served to increase the labor turnover.

Samples of this certified milk have been collected and examined at the health department laboratory. No other examinations have been made, officially, at least. From January 1, 1919, to March 31, 1920, 311 samples were examined, and 128, or slightly over 41 per cent of these samples, gave total counts of over 10,000 bacteria per cubic centimeter on agar at 37° C., 13 having total counts of over 100,000 bacteria per cubic centimeter. When it is considered that the maximum bacterial count allowed for certified milk is 10,000 per cubic centimeter, it is evident that this supply has failed to reach the consumer with as low a bacterial content as should be expected.

Upon further inquiry it was learned that this supply has not been "certified" by the local medical milk commission for several years, due to the fact that the dairy could not or had failed to meet the requirements.

Although this supply is probably reasonably safe the greater part of the time, its continued sale as a "certified" product violates all requirements of certified standards. It is obviously "mislabeled" and does not conform to the terms of grading provided in the city milk ordinance. In justice to other dealers and to maintain the high standards of truly certified milk, this dairy should be prohibited from marketing its product under the present label until it can again be certified.

GRADE B, RAW AND PASTEURIZED.

It was not possible to determine even approximately the average daily quantity of milk distributed in the city. As previously stated, there is no grade A milk sold as such. As nearly as could be determined, about 75 per cent of the milk sold by regular distributors is pasteurized grade B; the balance falling into grade B, raw.

Pasteurization.—Three of the larger dealers handle about 6,000 gallons of pasteurized products daily, and it was estimated that this represents about 75 per cent of the total supply.

The Clover Farm Dairy, by far the largest dealer, distributes from 4,000 to 5,000 gallons daily. This entire output is pasteurized locally, and a brief survey of the plant indicates that reasonable care is being taken and that the equipment is quite satisfactory. The holding method of pasteurization is used and automatic temperature recorders are installed.

One dealer, handling about 800 gallons of milk and milk products daily, operates a batch pasteurizer, heated with a revolving steam coil. The temperature to which the product is heated is recorded on a thermometer inserted in the end of the vat at a point not readily accessible for reading. The rating of this establishment is doubtful, and the milk inspector has been compelled to threaten closure in order to correct faulty methods and insanitary practices. Pasteurized grade B milk, buttermilk, and "reconstituted" milk are sold by this dealer.

One other dealer, whose total daily output is about 600 gallons, pasteurizes by means of the heating vat used in the reconstruction of milk. New equipment was being installed in new quarters, and it is doubtful if all the output of this dealer was being pasteurized.

The Gayosa Farms Dairy supplies all milk and milk products used by the three large hotels in the city. This dairy produces from 75 to 150 gallons, and buys of small dairies from 400 to 600 gallons daily. It was stated that all the bought milk was pasteurized, and the entire supply so treated during the summer months. This dairy would probably receive a very satisfactory rating on the usual score card.

RECONSTITUTED MILK AND OTHER MILK PRODUCTS.

There are three plants in the city manufacturing "reconstituted" milk, cream, and buttermilk. Part of this product is sold as whole milk and is supposed to be labeled as such. In the manufacture of this product milk powder and unsalted butter are mixed in varying percentages, heated and passed through an emulsifier. A considerable amount of reconstituted "cream" is sold to ice cream manufacturers.

Large quantities of buttermilk are prepared and sold. A part of this supply is made artifically from dried milk powder.

CONDITION OF DAIRIES AND DEPOTS.

A survey of representative producing dairies was made in company with the local dairy inspector. While the equipment at many and perhaps the majority of the smaller dairies is far from ideal, yet it would be possible to produce and distribute milk of a very satisfactory quality provided reasonably efficient methods of handling were adopted and practiced. Cow stables were generally clean and the majority have concrete floors. Milk houses are often crude structures, but many of them are used only for storing milk in cans for cooling purposes before delivery. In summer months facilities for proper refrigeration are often inadequate.

It will require constant supervision over methods of production and handling in order to secure for the consumer a milk supply of a satisfactory sanitary quality as determined by bacterial content. The present personnel engaged in the control over this important foodstuff is inadequate. Repeated legal prosecutions indicate the tendency to violation of the ordinances, and while court action and fines no doubt stimulate some of the dealers to adopt better methods, supervision and control over the milk supply should be extended.

Under present conditions it seems advisable to organize and develop a bureau of milk and food inspection to be operated under the direction of an officer who has had special training or experience in this branch of health department work.

The food value of milk and the importance of an adequate supply of pure, safe milk, especially for infant feeding, can not be too strongly emphasized. The present control exercised over the production, handling, and distribution of milk is inadequate, and the sanitary quality of a considerable portion of the total daily consumption is regarded as doubtful or suspicious.

PRIVATE COWS.

It was stated that there are probably 2,000 private cows stabled within the city limits, and although the owners are required to obtain a privilege permit from the health department there is practically no supervision or control over these sources of supply.

VIII. Division of Sanitary Inspection.

Under the direction of a chief sanitary inspector there are employed at present 14 sanitary inspectors. These men are given police authority and in reality constitute a sanitary police force. The majority wear uniforms. Many of these officers have been on duty for many years and have undoubtedly been appointed without any special qualifications. An impartial judgment would give a very low rating to the efficiency of this division. The present chief sanitary inspector has served for over 20 years, and his activities have been determined largely by political interference.

All sanitary inspectors are required to report at the office at 8 a. m. for instructions. The city has been divided into districts and each inspector is responsible for his district. As a check, they are required to phone in to the office at 11.45, 1, and 4.40 each day.

While there are certain routine duties performed by this force, the division of sanitary inspection has been a sort of dumping ground or clearing house for all sorts of complaints and nuisances. Although the collection and disposal of garbage, refuse, and night soil has recently been transferred to the engineering department, final agreement as to what department shall maintain supervision over the storage of garbage on premises and the sanitary condition of privies and yard closets does not seem to have been reached.

COMPLAINTS.

"Complaints" of nuisances of all sorts, received by phone or otherwise, are entered upon a blank form at the office. The chief sanitary inspector transfers these to a "complaint" blank and gives them to the proper inspector for action. Verbal orders are usually given to discontinue or abate the nuisance and when this fails to correct the condition a written notice is served. If no action is secured by this means, a warrant for arrest is served for appearance before the judge of the city court. A considerable number of such arrests are made and fines assessed.

A number of complaints are received in writing by reference from the chief of police and fire department. In many instances these are purely public nuisances and should be abated by proper action by these other departments.

ANNUAL INSPECTION.

Beginning about April 1 each year a house-to-house survey is made and conditions noted on a special survey form. From 25 to 50 or more premises are inspected daily by each officer and the survey is completed in from one to three months. These survey notes are filed and apparently no special use made of them. It was not possible to determine from these records the total number of privies in use, due to the fact that data is often incomplete and uncertain. There is no spot map or list of privies or other important nuisances.

OTHER ACTIVITIES.

Written notices requiring connections to city sewers, prepared by the plumbing inspector, are served by the sanitary inspectors. Reports of leaking water or sewer pipes or mains are referred to the proper departments. One inspector is assigned to the placarding of communicable diseases and the serving of vaccination notices. Permits are issued for keeping cows within the city limits, but there is no record of the total number of these private cows. Barber shops were recently visited, 17 arrests made and 7 fines assessed for violations of the city ordinances governing these establishments.

RÉSUMÉ.

The summary of all activities of this division, prepared by the chief sanitary inspector for the annual report of the health department for the year 1919, is compiled from the daily and monthly reports of the sanitary inspectors. Similar reports have been published each year.

Annual report, division of sanitary inspection, 1919.

Houses inspected	146,822
Cleaned	4,021
Yards inspected	121,083
Cleaned	6,660
Water-closets inspected	119,395
Cleaned	4,722
Earth closets inspected	5,067
Cleaned	2,800
Cellars inspected	9,245
Cleaned	1,301
Cisterns inspected	613
Oiled	11
Filled	25
Wells inspected	2,948
Cleaned	33
Filled	1
Stables inspected	8,934
Cleaned	2,211
Alleys inspected	10,076
Cleaned	2,604
Ponds inspected	187
Cleaned	33
Oiled	10
Water samples collected	107
Sewer connections ordered	214
Sewer connections made	181
Plumbing reconstructed	1,608
Other nuisances abated	15,427

Warrants issued	75
Warrants served	85
Special instructions	6,084
Notices to abate nuisance	15,882
Closets unstopped	2,151
Premises' water turned on	952
Posted and removed placards for contagious diseases	4,212
Notified parties where tuberculosis had been to come to clinic	3,400
Smallpox notices served	2,000

Made inspection in new annex, territory of Binghampton, and I find that they have 325 sewers connected with water and 362 earth closets. Just as far as I have made inspections I find them in fair condition. I have had 3,650 complaints in regard to water pipes, closets stopped, and sewers choked; and ashes and garbage, also grass and weeds.

I have reported to water company 265 leaks in streets and alleys.

Out of the 34 schools in the city they have all been inspected in regards to drinking fountains and water supplies, also sanitary conditions, and found them in best of condition.

Arrests made for violating sanitary laws and fined in police court, $375. I have reported to Sanitary Reduction Co. dead stock, 79 head.

CHIEF SANITARY INSPECTOR.

The above summary indicates an average of from 40 to 50 or more inspections or actions daily for each inspector or from 6 to 8 per working hour, at cost to the city of over $17,000 per annum. It has not been possible to discover much value received from such an expenditure. A survey of the existing conditions in nearly all parts of the city fails to find any tangible or visible evidence of the influence of such an inspection service.

The health department is still responsible for the general sanitary condition of the city and is charged with the supervision over the construction and maintenance of yard closets and privies. Not one of the hundred or more privies and yard closets seen by the writer could be called sanitary by any stretch of the sanitary conscience, nor was there any evidence of any active supervision over these dangerous sources of infection.

Although the health department should undoubtedly be held responsible for and be charged with the supervision over health hazards and insanitary conditions and practices in general, an equitable division among the several municipal departments of the supervision required to prevent and abate many of the so-called nuisances now thrown upon the health department would relieve this department of many duties of no public health importance.

In the plan of reorganization proposed as a result of the present survey, recommendations will be made that the department of streets, bridges, and sewers, now responsible for the collection and disposal of garbage, refuse and night soil, be provided with an adequate inspection service to enable it to exercise all necessary supervision and control over the storage of all refuse on premises, including the condition of streets and alleys and the maintenance of privies and yard closets. There must of necessity be close cooperation and coordination between this department and the health department.

In the same manner the abatement of many of the ordinary nuisances reported to the health department is properly a function of the police and fire departments. If these nuisances are successfully handled by the police, the energy of the health department can be expended in the control and correction of other conditions of far greater importance in promoting the general healthfulness of the city.

HOUSING CONDITIONS.

It would require a far more intensive study than seemed warranted during the present survey in order to determine the bearing of housing conditions upon the morbidity or mortality rates of tuberculosis or other contact infections. Having in mind the close relation between overcrowding, inadequate ventilation, unhygienic surroundings, and similar conditions upon the incidence of tuberculosis, the excessive death rate from this infection points strongly to the existence of such conditions in Memphis.

Before estimating the degree of overcrowding or the percentage of dwellings unsuited for human habitation, a careful house-to-house survey would be necessary. Approximately 40 per cent of the total population are colored. A smaller percentage, perhaps 10 per cent, of the white population are living under poor hygienic conditions. It is believed that at least 25 per cent of the total population are living under conditions that are detrimental to health.

Visits to many sections of the city revealed the fact that Memphis has indeed its "housing problem." A large proportion of the colored population are housed in buildings that should at once be condemned and vacated. Many of the others need extensive improvements. The more wretched types of dwellings occupy the low "bottoms" along the bayous and the more undesirable areas. They are found in nearly all wards. Aside from all grades of unhygienic environments, practically all of the poorer dwellings are provided with an insanitary type of "yard closet" or privy for the disposal of human excreta.

The fact that these undesirable areas are scattered over practically the entire city, even in the best residential wards, makes the problem a city-wide one, and the prevalence of preventable diseases among this class of poorly housed population undoubtedly influences the morbidity and mortality among the well-to-do and those enjoying good homes. Municipal authorities are beginning to realize that improved conditions and lowered sickness rates among the colored and poorer classes means less sickness and fewer deaths among the more favored classes.

There is at present practically no effective control or supervision maintained over housing conditions. The present building code needs study and revision, and the organization of a division of housing and sanitation in the health department is urgently needed in order to determine the most practicable means of solving this difficult problem. Present conditions can not be corrected overnight. They will require careful study and a firm and determined policy on the part of the municipal authorities.

IX. Sanitary Engineering Activities.

The position of sanitary engineer has never been included in the organization of the health department in Memphis. Measures for the eradication of malarial mosquitoes, the control of private wells and water supplies, housing conditions and that large popularized group of conditions called "nuisances," all require the experienced judgment and decision of a public official who should preferably possess the qualifications of a sanitary engineer.

Memphis has all these problems and most of them are vitally concerned as factors contributing to a high general death rate.

The public water supply is placed in charge of the water department, a division of the municipal department of public utilities, grounds, and buildings. Supervision over the numerous private wells and other private water supplies is left to the health department.

The public sewerage system is maintained and operated by the department of streets, bridges, and sewers. The plumbing inspector it attached to this department and given supervision over the installation, alteration, or repair of all plumbing and drainage systems, including "yard closets," and the enforcement of the plumbing ordinances.

The collection and disposal of garbage, refuse, and night soil is also a function of the department of streets, bridges, and sewers. This department at present has no inspection service to enable it to maintain any supervision over the storage of these domestic wastes prior to collection. Such supervision as has been maintained has been carried on by the health department.

Although the public water supply and sewerage systems and the collection of municipal and domestic wastes have been delegated to other departments of the city government, these items will be briefly reviewed in order to discuss their bearings upon the public health. In the chapter on recommendations offered for a reorganization of health department activities a somewhat radical departure from the present assignments of municipal activities will be offered.

THE PUBLIC WATER SUPPLY.

At least two epidemics of typhoid fever in Memphis have been attributed directly to gross pollution of the public water supply. The epidemic in 1911 may also have been due to this same cause, although there are no epidemiologic records covering this epidemic. If this public supply is liable to sudden gross pollution, the question naturally presents itself—can dangerous contamination take place from time to time, in a lesser degree, without being recognized?

A study of the curve of mortality from typhoid fever already presented does not indicate that the public water supply has been any considerable factor in the typhoid incidence in Memphis. A knowledge of the physical features associated with the collection system of this supply, however, raises a question of grave doubt as to whether it can be considered safe for drinking purposes under present conditions without additional safeguards or treatment.

The growth of the city is already taxing the capacity of the present supply, and this fact, together with the absence of storage facilities, has been responsible for increasing rates on fire insurance. With a view of remedying these conditions, a consulting engineer has been employed by the city for the purpose of further developing the system and increasing its capacity.

The following brief description of this supply is presented in order to point out certain features that, it is believed, constitute a definite health hazard and which must be recognized and remedied so as to avoid such public disasters as have already been experienced.

Source of supply.—Memphis is said to be the largest city in the United States taking its public water supply from artesian wells. Underlying a large area of Tennessee, Arkansas, and Mississippi is a deep water-bearing sand, geologically known as the La Grange sands. These artesian sands have a thickness of from 700 to 800 feet, and at Memphis are overlaid by about 300 feet of stiff blue clay interrupted with two 10-foot layers of sand and gravel. This water-bearing sand outcrops many miles to the north and east of Memphis, and the water, collected from large infiltration areas, reaches the city after extensive filtration under natural conditions through enormous layers of sand.

Such a source of supply is undoubtedly safe, unless it is artificially contaminated at or near the city through some puncture of the protecting clay stratum. This possibility is probably remote.

Collection systems.—In 1874, a private company installed a plant and delivered water from the Wolff River. The present well system was first developed in 1888. The city purchased the works in 1903. At present, the entire city supply is collected from drilled wells, the depth varying from 400 to 600 feet. Most of the wells are 10 inches in diameter, water entering through 50-foot Cook strainers. About 180 wells have been drilled since 1888, and of these, about 60 are now in use. When the yield falls too low, due to clogging, wells are abandoned and the casings are filled with cement. The wells are located in city streets or alleys.

Three separate systems or plants are in operation—(1) Auction Avenue plant, (2) Central Avenue plant, and (3) the so-called segregated wells. Each plant delivers water to the general system of mains so that, although the original source of water is the same, any contamination of one of the three collection systems may reach practically all parts of the city.

1. Auction Avenue plant.—This represents the original plant and at the present time supplies from 50 to 60 per cent of the total daily consumption. About 40 wells are now in use. In order to prevent surface pollution from reaching the water-bearing level, an outside casing has been driven down around the well casing. These outside casings extend to various depths and there is doubt as to the tightness of the joints made in the clay at the lower ends.

Water from these wells flows by gravity into masonry tunnels which are located in the clay stratum about 90 feet below the ground level. The wells are connected with two tunnels by "drifts" about 24 inches square, lined with ship-lapped plank. The tunnels are 5 and 6 feet, respectively, in diameter and the total length of drifts and tunnels is said to be about 20 miles. Water from the tunnels flows to a wet well constructed of masonry 10 feet in diameter and located at the plant.

Three Worthington compound, condensing, vertical steam pumps, of a daily capacity of 10,000,000 gallons each, are in use and pump the water from the wet well directly to the supply mains under an average pressure of about 50 pounds. The minimum output from this plant is given as 10,000,000 gallons daily.

The drift and tunnel features of this system are believed to constitute a decided hazard and are directly responsible for the contamination of the supply which caused the typhoid fever epidemics in 1912 and 1919. In 1912 a flood stage in the Mississippi River overflowed a portion of the city and polluted water gained entrance to a tunnel through a manhole, the cover of which had previously been broken by accident. In 1919 a broken sewer main located near a tunnel resulted in a gross pollution of this supply.

In order to determine the actual condition of this collection system, the present superintendent of the water department personally inspected the drifts and tunnels while the pumps kept them comparatively free of water. It was found that many of the drift boxes had become partly rotted so that the joints in the plank and at the unions with the well casings and tunnels were leaking. Water was also forcing its way into the tunnels at numerous points. It has been estimated that the total yield from the tunnels exceeded the combined capacities of the wells.

The source of this leakage into the drifts and tunnels, independent of the water coming directly from the wells, can only be conjectured. If the pressure in the artesian sands is always sufficient to maintain a water level above the top of the tunnel system, this might support the assumption that the leakage is artesian water from lower levels. It seems, however, to be equally possible for surface water to find its way to the tunnel level. Under ordinary conditions surface water reaching this depth has been subjected to certain purification by passage through the sand and clay strata overlying the tunnel and may or may not be of a safe sanitary quality. On the other hand, it may be possible for surface water to penetrate more directly by means of abandoned or faultily constructed well casings or other means of more direct communication or the balance between the water from the deep artesian sands and the upper surface or ground water may be established at a level near or below the tunnel, so that any leakage into the tunnel system may well be regarded with suspicion.

2. Central Avenue plant.—There are five deep wells in this development, two being 14 inches, the others 10 inches, taking water from the same artesian sands by air lift, discharging into a concrete collecting well of a capacity of 100,000 gallons. The mechanical equipment seems adequate. The average daily pumpage is given as 5,000,000 gallons. The output from this plant is pumped directly to the mains.

3. Segregated wells.—Located in streets and alleys over an irregular line of about 10 miles there are 15 deep wells of similar construction to those previously described. Each well is equipped with a 100-horsepower motor-driven deep-well pump of a rotary type, of a capacity of 1,000,000 gallons per day, delivering water directly to the mains. The motors and pumps are placed in concrete underground chambers, reached through a manhole. They are thrown into service as needed and, while they would normally supply the demands of the district immediately around each pump, the surplus is distributed to the general system.

Distribution and cost of operation.—The total pumpage for 1919 was 5,478,246,000 gallons, representing an average daily consumption of slightly over 15,000,000 gallons, an increase of 1,333,500 gallons over the daily average for 1918.

There are approximately 27,000 services, about 75 per cent of which are metered. It is estimated that at least 95 per cent of the total population of the city use this public supply.

The total operating cost for 1919 was $309,387.34; the fixed charges, including interest and sinking fund, $189,777.36. The gross income was $512,040.51, leaving a balance of $12,875.81, which was applied to a previous overdraft. There are at present outstanding bond issues to the amount of $3,200,000.

Laboratory control.—The water department maintains no laboratory for the examination of this supply. Bacteriological examinations are made at the health department laboratory. Prior to 1919 these examinations were made only occasionally, usually upon some complaint. Following the typhoid epidemic of 1919, the total bacterial content of two samples has been determined on six days of each week. Tests for *B. coli* in sugar media are not made. The total count on agar at 37° C. after 24 hours' incubation varies from 0 to 4 or 5 per cubic centimeter.

In the face of recent history of typhoid fever epidemics and because of the fact that no treatment or other safeguard is applied to this supply, especially that from the tunnel system, daily examinations are surely indicated. Early knowledge of pollutions such as have already occurred would permit of effective treatment and reduce the dangers of a repetition of previous disasters. A sufficient number of samples should be collected daily from the several systems and examined for total bacterial count and the presence or absence of *B. coli*, in order to maintain a constant vigilance over the sanitary quality of the water from the various sources and to detect any introduction of dangerous pollution.

Quality of supply.—Reference has already been made to the several instances of gross pollution of this supply and to the average daily index of purity as determined by laboratory examination.

Consumers receiving water from the tunnel system offer frequent complaints concerning the physical properties of the supply. In summer this water becomes warm and unpleasant to taste. The entire artesian supply is said to contain iron in the proportion of about two parts per million gallons. Exposure to air liberates carbon dioxide and precipitates the iron in an insoluble form, resulting in serious damage to plumbing fixtures and making it unsuitable for laundry purposes.

Treatment.—There is no treatment of any form applied. There are also no storage facilities. In the plans being formulated for extension of the present system, a storage reservoir is contemplated of a capacity equal to about the average daily consumption. This will serve to better satisfy the fire underwriters and permit of the elimination of the excessive iron content.

In the event of a repetition of such polution as has already taken place and resulted in probably 3,000 cases of typhoid fever, even if it should be detected early, it would not be possible to entirely prevent an explosive outbreak of intestinal infections for the reason that no facilities are at hand for the disinfection of the polluted supply.

During the 1919 epidemic, the part of the tunnel system directly receiving the pollution was shut off as effectually as possible but not until some time after gross pollution had taken place.

Because of these conditions and because of the known leakage into the tunnel systems from unknown sources, the purchase and installation of chlorine disinfection apparatus and continuous disinfection of the tunnel supply was strongly recommended at the time of the present survey. With daily bacteriological examinations, both for total bacterial count and for the detection of the presence of *B. coli*, of samples taken preferably at the pump wells, thorough disinfection of the other supplies could be started within about 48 hours after dangerous pollution was first discovered. Disinfection should be undertaken also immediately upon the appearance of any definite indication of pollution as shown by bacterial analyses. Failure to make provision for adequate sterilization must be considered virtually criminal negligence, and the cost of installation would have avoided the lawsuits now pending against the city for monetary recompense for the lives lost and jeopardized during the last typhoid epidemic.

Future supply.—Increasing consumption has already brought about a recognition of the necessity for extending the present supply. The total operating cost in 1919 was $56.50 per million gallons or $91.30 including fixed charges. The cost of operation of the present system is high, and while no detailed study of comparative costs of a change to some other source of supply was made, the desirability of installing a modern filtration plant for the treatment of water taken from the Mississippi River should be seriously considered before expending further funds in the extension of the present source. It is believed that a water of better sanitary and chemical quality would be secured at a lower cost, provided the items of fixed charges can be advantageously adjusted.

Memphis, like many other communities, has boasted of the purity of its public water supply. It is indeed time now to recognize the rôle it has played in contributing to preventable morbidity and mortality and to make suitable provisions for properly safeguarding the present supply or obtaining a new supply that is not open to suspicion. A really safe water supply is a valuable asset, and the cost of such an asset should be a minor consideration.

PRIVATE WATER SUPPLIES.

No record could be secured of the number of private water supplies in use. Some of the larger hotels and industrial plants have well supplies, which tap the deep artesian sands, and it is estimated that possibly 3 per cent of the population are using water from private wells.

As far as could be determined, there has been no special attention given to these deep-well supplies.

Private wells.—Scattered about the city, mainly in the outlying sections, there are several hundred private wells, located near sidewalks or in back yards. These wells are said to have a depth of from 50 to 75 feet, terminating in clay and lined with either iron or vitrified pipe. One length of tile projects above the ground and water is drawn up by windlass and receptacle of a sand-bucket type. The projecting tile usually has no protection whatever against willful or accidental contamination of the well.

These wells are usually located in sections that are as yet unsewered, and consequently are frequently in rather close proximity to insanitary, soil-polluting privies. In the past some of these wells have been condemned and abandoned wherever the public water supply was available.

There is no attempt at routine laboratory examination of samples of water from these private wells. They are obviously of faulty construction, lacking in adequate protection at the surface, and in the absence of bacteriological examinations many of them would be condemned from the findings of a sanitary survey alone.

In view of the above a thorough survey of all private wells is indicated, and a careful laboratory study should be made of the sanitary quality of each supply and all definitely polluted or suspicious wells should be immediately condemned and abandoned.

The relation of contaminated water supplies to the incidence of typhoid fever and various intestinal diarrheas is well established and because of the excessive mortality in Memphis, particularly from typhoid fever, these private well supplies should be at once eliminated as a contributing factor to this class of preventable diseases.

Bottled water.—The recent epidemic of typhoid fever served to promote an increased demand for bottled water and quantities of "spring" water have been sold in the city. Many families had already been using these spring waters because of the high iron content of the city supply. This practice introduces another problem, that of the sanitary quality of the spring water supplies and it becomes incumbent upon the health department to investigate these supplies and determine their purity. There have apparently been undertaken no measures for the control of these bottled waters.

DISPOSAL OF SEWAGE.

A system of sewers was installed in Memphis in 1880, and in 1898 about 70 miles of mains had been constructed. At the present time sewers have been made available to probably 99 per cent of the total population of the city and it is estimated that about 95 per cent are connected. Permits for connections are required, but the records are incomplete.

Sewage, both domestic and storm water, is discharged without treatment, directly into the Wolff and Mississippi Rivers.

Extensions to the original system have been continued until, in some sections, the mains have reached the surface. To reach these sections, it will be necessary to construct new collecting mains and it was understood that plans are now under way.

Outside yard closets.—In practically all the sections occupied by the colored and to some extent by the poorer white population, so-called "yard closets" are in use. These closets are of the hopper type and are flushed by a hand-operated valve on the water pipe line which supplies water directly to the hopper. They are connected to sewer laterals, the traps being vented with a 4-inch iron stack which is extended above the roof of the housing. The small wooden structures that house these closets are for the most part poorly constructed and usually dilapidated and neglected.

In company with the mayor, the commissioner of sewers, his assistant and the chief sanitary inspector, several hundred of these yard closets were inspected for the purpose of indicating from personal observation the decided health menace arising from the construction and operation of this kind of closet for the disposal of human excrement. The evidence secured from this trip of inspection was most convincing.

The hoppers are of a type practically impossible to be thoroughly cleansed with the flush provided and flushing depends entirely upon the whim of the user. The water was found shut off in several and a number were filthy beyond description. None of the superstructures made any pretense at being fly proof. To a varying extent, there is practically always an exposure of fecal matter that has dried on or been left adherent to the hopper.

These yard closets are to be found in nearly every ward in the city. They are in use in close proximity to the Bruce High School, in the shadows of the Baptist Memorial Hospital, and are scattered about the business district and in nearly every residential section. The total number now in use could not be ascertained, but it is estimated that probably at least 40 per cent of the total population use this method of disposal.

In the absence of epidemiological proof to the contrary, it is believed that these yard closets must be considered a factor in the high summer prevalence of typhoid fever in Memphis. Their distribution, construction, and the insanitary condition in which they are generally maintained must be considered as increasing the number of at least potentially dangerous foci from which the infectious agents of intestinal diseases may be spread. The difference between these yard closets and the insanitary open privy as health hazards is the relative degree of exposure of fecal matter that takes place.

The correction of these sanitary hazards should receive the immediate attention of the municipal authorities. The problem is a difficult one from certain aspects. The majority of the occupants of the premises where yard closets are provided are colored tenants and the installation of inside closets is usually impossible.

Until there can be effected some substitution of a more sanitary type of hopper in these yard closets, systematic inspection should be undertaken in order to reduce as much as possible the menace arising from careless operation of these closets. Although difficult of enforcement, the insistence of reasonably effective fly proofing of at least the hopper will result in some reduction in transference of infectious discharges by flies. Under proper supervision no extensive personnel force will be necessary for such an inspection service.

Privies.—The city ordinances provide for so-called "earth closets" where public sewers are not available. A water-tight box or bucket is required and dry earth or ashes must be used "at least once a day" to cover all deposits, the night soil to be collected by the city "once every two weeks or oftener if necessary." All privies are placed under the supervision of the health department.

There are about 1,300 of these earth closets in use in unsewered sections. No record could be secured of their actual number or location. A personal inspection of a considerable number revealed conditions that should constitute a disgrace to any self-respecting community. In apparent compliance with the ordinances, some sort of a receptacle is usually provided, in many instances a galvanized tub or wooden pail. In one alley about 30 privies were found, the receptacles overflowing or leaking onto the ground, the space under the seat open in the back with no covering whatever. This was in a colored section of over a hundred houses. The owner of this property lived nearby and also maintained an insanitary privy.

The alley cleaning department was recently transferred to the street department. Night soil is collected in tank wagons and discharged into the sewer at two disposal stations.

The inspection of these privies has been carried on under the division of sanitary inspection. Personal observation indicated that there has been but little supervision maintained over the sanitary condition of this decidedly dangerous method of disposal of human excrement. There was no evidence of any supervision. A maximum exposure of contents with excessive soil pollution prevailed generally. In the sections using the private wells previously described, this uncontrolled pollution of the soil obviously exposes these wells to dangerous contamination.

Until public sewers can be made available and the insanitary privy abandoned, there is only one remedy for this method of excrement disposal and that is the installation of sanitary privies, maintained under adequate and constant supervision. A water-tight receptacle, protected from flies, with frequent collections by the city scavengers, should be the minimum requirements.

In considering the problem of the maintenance of the necessary supervision over these privies, it would seem desirable to assign the inspection service to the department responsible for the collection of night soil, namely, the department of streets, bridges, and sewers, and this suggestion was favorably received by the commissioner of this department. Under the present administration it is believed that this plan of developing the necessary inspection service in connection with the scavenging department will be feasible and adequate and avoid any divided responsibility in the supervision of this problem.

COLLECTION AND DISPOSAL OF REFUSE.

Garbage.—The collection and disposal of domestic garbage and other forms of refuse, including ashes and trash, was transferred from the health department to the department of streets, bridges, and sewers early in 1920. The collection service and equipment owned by the city is being reorganized and extended at the present time. Heretofore collection has been inadequate and many complaints have been made to the health office.

It was estimated that the daily production of domestic wastes, such as garbage, ashes and other refuse, averaged about 750 cubic yards. The present equipment can handle a maximum of about 450 cubic yards, but only about 360 cubic yards are collected daily. New wagons and motor trailers are to be added in order to increase the collections.

All of the garbage and some of the trash is disposed of by burning it in three incinerators owned by the city and located in the three collection districts. From one to three tons of coal are required daily to complete the combustion of these wastes. The total capacity of the three incinerators is given as 195 tons per diem and they are being operated without apparent nuisance.

Ashes and some other refuse is disposed of mainly by utilizing it for filling at various dumps.

According to the estimates by the city commissioner in charge of refuse collection, the city has been collecting only about 50 per cent of all refuse produced. There has been but little control over the disposal of the balance. This has been left largely to the producer. A considerable quantity of refuse, especially ashes and trash, has been thrown into the bayous or otherwise disposed of with the least possible inconvenience.

The popular conception concerning the relation of garbage and other refuse to the public health is based upon inherited misconceptions of the origin of disease and its usual mode of transmission. Filth and disease are still closely associated in the minds of many individuals and for this reason health departments have been charged with the collection and disposal of all forms of municipal wastes. The discovery of the true causes of many diseases and their mode of spread have transferred the attentions of the sanitarian from "filth" as such and conditions of environment to the infected individual as the vital factor in the spread of most diseases. Filth of any sort is still just as repugnant to our senses of sight and smell, but its relation to disease is rather an indirect one and refuse collection becomes more a problem of municipal housekeeping and civic pride in our environment and appearances of general cleanliness.

It is true that garbage will, under certain conditions of neglect, breed flies or attract flies and rodents, and it is known that flies may act as mechanical conveyors of infection; hence the bearing of garbage upon disease transmission. If, however, fly breeding in stable manure is reduced to a minimum, and garbage is properly stored in covered receptacles and collected at regular intervals, the health department has no special interest in garbage as a health hazard, and the supervision over the garbage can and the storage, collection, and disposal of garbage, as well as other classes of household refuse, may properly be assigned to the scavenging department.

Under present arrangements the collection and disposal of all refuse is a function of the department of streets, bridges, and sewers. In order to maintain adequate supervision over the personnel engaged in the collection service, it will be necessary to employ supervisors or inspectors. But little expansion of this force of inspectors would be required in order to enforce the city ordinances or regulations governing the storage of garbage and other refuse on premises before its collection. The employment of supervisors or inspectors to maintain a satisfactory collection service and sanitary inspectors to enforce regulations governing the type of garbage can to be used and the method of storing garbage brings about a duplication of personnel, a division of supervision over a municipal function that will result in lost motion, added expense, and disclaimers of responsibility.

The development of an adequate inspection service in connection with the present refuse collection department was discussed with the commissioner of this department and the adoption of such a plan was considered the most practicable and economical means of maintaining the required supervision over all phases of refuse storage, collection, and disposal, and it is, therefore, recommended. This places the responsibility where it properly belongs and relieves the health department of a function that has but little, if any, bearing upon public health.

The development of this inspection service will not be discussed here. With harmonious interdepartmental relations it should be possible to organize and carry on such a service and bring about really effective control over a difficult municipal problem.

Stable manure.—Flies breed by preference in horse manure. It requires about 10 days during the summer for the development of the egg into the mature fly. Consequently, in order to prevent or interrupt the breeding of flies in this refuse material in a city block it is necessary to either securely protect it from the access of flies or remove it at intervals of from five to seven days during the breeding season. Attempts to prevent fly breeding by storing stable manure in fly-proof pits or by chemical treatment of the manure are often failures or only incompletely successful. Complete and frequent removal answers all the requirements and is usually the method of choice.

Flies are undoubtedly capable of transferring infectious material and have been convicted as agents in spreading typhoid fever and other intestinal disorders, and they may convey infection in such diseases as tuberculosis, smallpox, scarlet fever, and other similar affections.

As far as could be determined there has been no effective supervision maintained over fly breeding in Memphis by requiring proper disposal of stable manure. Action has been apparently taken usually only upon complaint.

In Memphis the department of streets, bridges, and sewers has been given the function of city scavenger and is now charged with the collection and disposal of garbage, refuse, and night soil. Although it may not be feasible for the city to collect stable manure, it is believed that supervision over its storage and frequent removal may logically be placed in this same department and maintained through a newly created inspection division previously referred to in the discussion of garbage and refuse disposal. Under competent supervision, fly breeding in stable manure can be satisfactorily controlled and this class of waste eliminated.

SUMMARY OF PRESENT HEALTH ACTIVITIES AND SANITARY CONDITIONS IN MEMPHIS.

The city of Memphis, with a present population of slightly over 160,000, expended approximately $86,700 during the calendar year 1919 for the operation of its health department, or about 55 cents per capita. This sum does not include any items pertaining to the collection and disposal of garbage, refuse, or night soil, the operation of the city hospital, or the allotment of about $10,000 made to the associated charities and Public Health Nursing Association. In other words, the $86,700 represents the expenditure made for those municipal activities regarded as purely public health functions.

An expenditure of 55 cents per capita is a reasonably adequate investment in public health work for the average city of the size of Memphis. Although it is perhaps difficult to audit the activities and results of public health work in terms of sickness prevented, lives saved, or other expressions denoting effective application of measures undertaken for the promotion of health and sanitation, there should nevertheless be some indication of the effect of such an expenditure upon the vital statistics or the composite sanitary picture of the city in order to justify further appropriations.

A study of the mortality statistics of Memphis for the past 20 years reveals no reduction in the general gross death rate; in fact there has been a decided increase in the death returns for certain important preventable diseases, notably typhoid fever and tuberculosis, and this increase has apparently been due to an increasing incidence of these infections in the colored population. Of the total deaths from disease occurring each year, about 40 per cent have been due to causes ordinarily accepted as preventable.

A rather thorough survey of the general sanitary conditions existing at the present time would seem to indicate either that there has been an absence of effective supervision or that local conditions are especially difficult to control.

In view of what has already been set forth in the body of this report there would appear to be sufficient basis for the conclusion that the conditions responsible for high morbidity and mortality rates and the general sanitary status of the city are very largely the result of an unorganized health administration, conducted under part-time untrained chief executives who have been supported by a personnel for the most part unqualified for their positions. The influences of pernicious politics must be credited with most of the responsibility for such a condition of affairs.

The composite health of a city, as reflected in its morbidity and mortality records, is of vital concern to the city itself and a component factor in determining the general healthiness of the State of which it is a part, as well as that of the country as a whole. The status of health and sanitary conditions obtaining in any city underlies its industrial and business activities, and that city will not long continue to be progressive or prosperous which countenances excessive death rates from preventable causes or remains satisfied with a low sanitary rating.

Health administration in Memphis has been continued mainly along lines of least resistance and shows but little indication of progress or development. Positions created by laws establishing the original "board of health" have been carried along in spite of the fact that the board was abolished in 1909. The duties of the present superintendent of health have not been clearly defined, and his salary has been fixed by law on a basis of $3,000 per annum. Organization of personnel is weak, there being no well-defined bureaus or divisions for prosecuting any definite administrative policy under full-time trained chiefs of division.

These statements are not put down in the nature of destructive criticism, but rather intended as an explanation of many of the conditions emphasized by the present survey.

There has been but little attempt to carry on any campaign of publicity that would secure the intelligent cooperation of the general public and make possible higher standards of healthfulness and sanitation. It is true that many of the lessons of personal hygiene must be self-taught, but there remains a wide field of activity for the health authorities, and the average individual must be taught his responsibility in avoiding infection and preventing its spread to others.

The existing laws pertaining to health and sanitation are scattered and in some instances out of date. A careful revision should be undertaken and the resulting laws, ordinances, and regulations should be codified and made readily available.

The publication of the monthly annual reports has served no special purpose. These reports are mainly statistical, and as such are of but little, if any, real value, and serious errors appear in many of the tables.

The registration of vital statistics has not been satisfactory, the records of births and deaths are poorly kept, and they have served no useful purpose as far as the health department is concerned. The registrar of vital statistics has no official status in the health department, although his deputy is now a clerk in the department and the records are readily available. It would seem most desirable to secure the necessary amendments to State and local laws to permit the appointment of a regular officer of the health department to the position of registrar of vital statistics. This change would undoubtedly bring about considerable improvement in the registration of births and deaths.

In the present organization, such activities as have been undertaken show but little interrelation. One of the most important functions, that of the control of communicable diseases, has not been properly developed. Morbidity reporting is only fairly satisfactory or complete. There has been practically no epidemiologic study made of those diseases responsible for excessive morbidity, and mortality rates and office records are quite incomplete and meager.

Such control measures as have been undertaken as routine are uncertain as to their scope and effectiveness. Tuberculosis, a large factor in the annual mortality, is practically uncontrolled. The problem of infant mortality, including prenatal instruction and supervision over the health of preschool ages, remains virtually untouched. Adequate and effective control is lacking over such diseases as typhoid fever, malaria, diphtheria, and the usual infectious diseases of childhood.

Public health nursing, now recognized as one of the most powerful weapons of a modern health department, has been subordinated to a nursing service developed in connection with a medical inspection of schools.

Facilities for the hospitalization of communicable diseases are entirely inadequate. The small, poorly equipped 15-bed hospital now used for this purpose should be abandoned and provisions made for a modern communicable-disease hospital of at least 100 beds.

Memphis acquired the distinction of heading the list of large cities in 1919 with a typhoid death rate of 58.4 per 100,000. This high death rate was due to an epidemic brought about by a sudden gross pollution of the city water supply with human fecal matter, the direct result of a broken sewer main. A similar extensive water-borne epidemic of this disease occurred in 1912, due to flood conditions and sudden contamination by raw sewage. Deaths from typhoid fever reached a still higher point in 1911, and while epidemiologic evidence is lacking, there seems to be reason to believe that the excessive mortality for this year, largely the result of a serious epidemic, may very probably have been due to an unrecognized contamination of the public water supply.

This history of repeated water-borne epidemics of typhoid fever, and the brief description of the present water supply system submitted in this report, is considered sufficient evidence to indicate the urgent necessity for prompt action for the immediate correction of the conditions responsible for previous extensive epidemics. There appears to be sufficient evidence to support the condemnation of the old tunnel collection system of deep well supplies and to warrant the recommendation of continuous disinfection of this supply or its abandonment.

Numerous other factors undoubtedly responsible for the continued high endemic incidence of typhoid fever have been noted, namely, grossly insanitary privies; insanitary "yard closets" widely distributed over the city; abundant fly breeding and inadequate supervision over the collection and disposal of garbage and other organic "filth"; a doubtful sanitary quality of milk supplies due to inadequate supervision and control; noneffective control measures over public eating places and food supplies in general; and the influence of poor housing conditions affecting a relatively large proportion of the population. These factors, with the lack of effectual control over actual cases and carriers, explain the continued high mortality from this disease.

With the exception of the operation of several milk stations during a few months in the summer, the health department has undertaken practically no activities related to infant welfare, including accurate registration of all births, prenatal instruction, the control of midwifery, or the promotion of the health of preschool ages and children in industry. Allied organizations such as the associated charities and Public Health Nursing Association have attempted some prenatal and infant welfare service, but there has been no correlation between the activities of these private organizations and the health department.

The appalling mortality from tuberculosis has been emphasized. The gross death rate from all forms of this infection has been steadily increasing, due to a truly alarming increase in the fatality among the negroes, as shown by the table and chart presented. This disease has been very incompletely reported, and its control has been emphatically neglected. The erection of the Oakville Sanatorium should serve as a nucleus for a strenuous campaign of publicity and determined effort at control.

A review of published annual reports of the health department might indicate that the medical inspection of school children had been receiving considerable attention. On final analysis, however, it would be difficult to point out any definite results obtained from past expenditures of considerable sums of money for a large medical personnel engaged for part-time service as medical inspectors. At present there is virtually no medical supervision ovér school children. Sixteen health department nurses spend most of their time in the schools on routine work, and while something has undoubtedly been accomplished by this force, there is lacking any fixed policy or plan of medical supervision. The importance of such supervision has been clearly established, and in undertaking a reorganization of the health department a division for the health supervision of school children should be included and developed in connection with a department of school hygiene established under the board of education.

The venereal-disease problem has already received attention and plans for continuing this important work as part of a State-wide program have been proposed by the United States Public Health officer in charge of the State division of venereal diseases, a part of the State board of health organization. Clinic facilities and a detention home for white women have been provided. An allotment of $5,889 by the city to match an equal amount of Federal funds to carry on control measures during the coming fiscal year ending June 30, 1921, has been authorized. A division of venereal diseases should be established as a subdivision of the bureau of communicable diseases in the reorganized health department and all local activities placed under the supervision of this division.

Malarial infection has very frequently been returned as the cause of death and, it is believed, often without the support of laboratory diagnosis. The exact incidence of true infection by the plasmodium of malaria has not been determined, and deaths reported under this classification cover a multitude of shortcomings as to diagnosis. Better reporting and control of actual cases confirmed by laboratory examination of blood smears is clearly indicated. Mosquito eradication measures undertaken first in 1917 under United States Public Health Service direction should be considered and a tentative plan and budget for the coming season has been presented.

The city chemist, as chief of the health department laboratory, in addition to such diagnostic work as is being carried on, is charged with the enforcement of the pure-food ordinance, supervision over meat and milk inspection, and control of food inspection, and the preparation of narcotic solutions distributed by the antinarcotic dispensary. Samples of the city water supply are examined daily. While considerable credit should be given to the present incumbent of this office, the establishment of separate divisions for the control over milk and the handling of foodstuffs will relieve the laboratory director of these responsibilities and permit the development of a public health laboratory per se. When the proposed new quarters are available, ample provisions should be made for supplementing the present equipment, and every effort made to enlarge and expand the activities of the laboratory by extending its usefulness for diagnostic purposes and encouraging practicing physicians to take every advantage of the facilities offered.

The control of foodstuffs, including supervision over public eating places and the preparation and handling of food, should be more rigidly enforced. The importance of the health of employees, the effective sterilization of eating utensils, and proper methods of handling and displaying articles of food, has apparently not been sufficiently stressed.

A force of two inspectors for maintaining the necessary supervision and control over all sources of milk supplies is obviously inadequate. Progress has probably been made in securing somewhat better equipment and methods at many of the near-by producing dairies, and the tuberculin testing of dairy cattle has been very well enforced. The grading of milk is desirable, but steps should be taken to secure milk of grade A quality, none of the present supply meeting the requirements of this grade. The sale of milk now offered under a "certified" label should be discontinued until this supply can be properly certified. Laboratory examinations and a knowledge of present methods of production and handling appear to substantiate the statement that the sanitary quality of a considerable portion of the total milk distributed in the city must be accepted as doubtful.

The importance apparently attached to the abatement of general nuisances has been emphasized by the establishment of a division of sanitary inspection and the employment of about 15 inspectors, an item of approximately $20,000 annually. The results that have been accomplished by this inspection service do not seem to warrant such an expenditure of public funds. In the organization suggested, control over general sanitary problems is vested in a division of housing and sanitation.

To avoid any division of authority or shifting of responsibility, the inspection and supervision over the storage, collection and disposal of all municipal wastes, including garbage and night soil, should be a function of the department charged with its collection and disposal, namely the department of streets, bridges, and sewers. The supervision and control necessary to prevent the creation of nuisances arising from improper methods of storage and disposal of these wastes can, and it is believed that they will, be satisfactorily exercised by this other department, and the health department will be relieved of a function of no direct public health importance.

It is believed that sufficient evidence has been presented to warrant a complete reorganization of the Memphis health department. In presenting the following plan of organization, the personnel and budget suggested is based upon present urgent needs and existing conditions requiring prompt action. Under a full-time trained executive director of health, the growth and expansion of health activities will follow naturally, provided the moral and financial support of the municipal authorities and the general public is secured and maintained.

RECOMMENDATIONS FOR REORGANIZED HEALTH ACTIVITIES.

In submitting recommendations for a reorganization of the present health department in Memphis, there is presented, first, a suggestive plan of organization and budget, indicating a nucleus or the minimum personnel and funds that will be required, and, second, a brief discussion of certain phases of the proposed organization.

Proposed Organization and Budget (One Year).

Department of Public Affairs and Health.

COMMISSIONER OF HEALTH.

(Mayor)

Department of Health.

DIRECTOR OF PUBLIC HEALTH.

Salaries and expenses.

I. BUREAU OF ADMINISTRATION.

Director of public health	$5,000
1 secretary and chief clerk (also deputy registrar of vital statistics)	1,500
1 messenger	900
Miscellaneous supplies and expenses	1,000

II. BUREAU OF MEDICAL INSPECTION.

Director of public health in charge.	
1 clerk and stenographer	1,500
Division of communicable diseases:	
1 clerk and stenographer	1,500
1 medical inspector	2,500
1 supervisor of nurses	1,800
7 public health nurses (white), at $125 per month	10,500
3 public health nurses (colored), at $75 per month	2,700
1 quarantine officer	1,500
Transportation, supplies, and expenses	2,600
Venereal-disease control:	
Personnel and expenses charged to a special allotment of $5,889.	
Division of child hygiene:	
Chief of division	3,500
5 medical inspectors (part time), at $50 per month	3,000
4 public health nurses (white), at $125 per month	6,000
1 public health nurse (colored), at $75 per month	900
Transportation, supplies, and expenses	2,250

III. BUREAU OF LABORATORIES.

Director	3,000
1 technician	1,500
1 laboratory assistant	900
Miscellaneous supplies and expenses	1,500

IV. BUREAU OF MILK AND FOOD INSPECTION.

Director (sanitary engineer).[1]	
1 assistant director (veterinarian)	2,400
2 dairy inspectors, at $125 per month	3,600
1 meat inspector (veterinarian)	1,800
3 food inspectors, at $125 per month	4,500
Transportation, supplies, and expenses	2,500

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[1] One sanitary engineer in charge of bureaus IV and V.

V. BUREAU OF SANITARY ENGINEERING.

Director (sanitary engineer)	$3,500
1 clerk	1,250
Transportation, supplies, and expenses	1,200
Division of housing and sanitation:	
Chief of division (chief of sanitary police)	2,500
Seven sanitary police at $125 per month	10,500
Miscellaneous supplies and expenses	500
Division of mosquito eradication:	
In charge of sanitary engineer.	
During the breeding season, additional personnel and supplies as outlined in appendix, charged to separate allotment. Estimated cost, 1920, $10,000.	
Total one year	90,300

NOTE.—All personnel are to be full-time unless otherwise noted.

APPOINTMENTS, DUTIES, AND FUNCTIONS.

As provided under existing laws, the mayor, as commissioner of public affairs and health, is held directly responsible for the conduct of the health department.

In attempting the reorganization of the present health activities of the municipal government as herein suggested, amendments to certain laws and ordinances now in force will be necessary. Provisions by law must be made for the appointment of the director of public health and his subordinate assistants and the powers and duties of the director should be clearly defined. Laws and ordinances now in force pertaining to the health and sanitary regulation of the city should be carefully studied and revised to meet present conditions and requirements and finally codified.

PUBLIC HEALTH COUNCIL.

An advisory public health council, developed along lines followed in establishing similar councils in connection with some State and municipal health departments, would seem to be most desirable, particularly because of the urgent need of enlisting the support and full cooperation of the general public and all agencies engaged in health activities or whose services might properly be so extended.

Membership in the council should be selected with care and only with a view of further promoting the public health. It is suggested that five members be appointed by the mayor for terms of five years, one term to expire each year in rotation. In making these appointments, due consideration should be given to secure a fair and equitable representation of various civic activities, including (1) the local medical profession; (2) the chamber of commerce and business interests; (3) the federated women's clubs; (4) the charitable, private nursing, and allied organizations; and (5) the legal profession. In order to escape future political influences it would be most desirable, if possible legally, to have nominations for membership made to the mayor by the representative bodies.

A public health council of this character might be compared to various commissions now appointed, such as the park commission or the city planning commission.

For the present, the council should perhaps have no executive, administrative, or appointive authority. In developing such a council, consideration should be given to the desirability of extending its usefulness by delegating to it certain powers and duties such as proper authority to visé the expenditures of the health department, to pass upon annual budgets, to approve and assist the director of health in formulating rules and regulations for the preservation and promotion of the public health for presentation to the city commissioners for final adoption.

Council members should serve without salary or other compensation except reimbursement of actual expenses duly authorized.

Meetings at stated intervals should be held with the mayor and director of health as ex officio members, and all business relating to the public health should be considered. The selection of a chairman and the adoption of by-laws are details of organization.

A properly constituted public-health council will be of invaluable service and assistance to the municipal authorities, and particularly to the director of health in deciding upon general policies to be adopted. It would act as a medium through which the general public could be reached and its attention and cooperation secured. On the other hand, the support and approval of the council would strengthen the position of the director of health in dealings with the municipal authorities.

DIRECTOR OF PUBLIC HEALTH.

Successful administration of the health department will depend largely upon the choice made in selecting its chief executive officer or director of public health. He should be chosen after careful consideration of his qualifications for this important position and his adaptability to local conditions. He should be required to devote his full time to his official duties, his tenure of office should depend only upon his efficiency and conduct, and he should be paid a salary commensurate with the importance of his position.

The positions of superintendent of health, health officer, and secretary as now established should be abolished and the necessary amendments to existing laws and city ordinances should be carefully drawn and passed to permit a complete reorganization of the department.

ORGANIZATION AND PERSONNEL.

The director of health should be given full authority to reorganize the health department and to appoint and remove all subordinate personnel.

The plan of organization recommended above will require time for its development and changes will no doubt be indicated as progress is made and conditions change or new problems present themselves. The outline presented is fairly self-explanatory and only a brief discussion of certain items will be undertaken.

BUREAU OF ADMINISTRATION.

In addition to the management of all business of the department and general supervision over the several bureaus and divisions, there will be needed an active educational publicity campaign, and attention should be given to improvement in the registration of vital statistics.

DIVISION OF COMMUNICABLE DISEASES.

As a division of the bureau of medical inspection, the control of communicable diseases represents one of the most important functions of the department. The chief of this division should be a full-time, trained executive, properly qualified for the position. As assistant director of health, he should assume entire charge of the department in the absence of the director.

In the face of excessive death rates from such diseases as typhoid fever and tuberculosis, the program for this division is a strenuous one. An intensive and extensive epidemiologic study of those infections showing high morbidity rates should be undertaken and the necessary control measures instituted and diligently prosecuted.

Sixteen public-health nurses are included in the organization proposed. Eleven have been tentatively assigned to public-health nursing in connection with the control of communicable diseases and five to child hygiene activities. A redivision of these nurses may subsequently be indicated. The importance of an adequate public-health nursing service needs no special discussion. Under proper supervision, these nurses will render invaluable services in instituting effective bedside prophylaxis, promoting personal hygiene and securing the active cooperation of the individual, and in addition assist the chief of the division and the medical inspector in the epidemiologic study of cases reported and in carrying out necessary control measures.

DIVISION OF CHILD HYGIENE.

This division includes school medical inspection and all infant and child welfare activities. As progress is made in developing these lines of activities, additional personnel will be required. For the present it is believed the organization suggested will permit the inauguration of a definite program for the health supervision of school children, the prevention of unnecessary infant mortality, and the promotion of child welfare work in general.

Past experience points to the desirability of providing one medical inspector and one school nurse for every 2,000 to 3,000 children enrolled in the schools. On this basis from 8 to 12 school physicians and an equal number of school nurses would be required.

The duties to be undertaken under the head of school medical inspection have been briefly outlined in the body of this report.

In outlining a plan for better conservation of child life, provision should be made for the necessary supervision and attention to prenatal conditions responsible for unnecessary maternal sickness and death in childbirth and unfavorable or fatal issues to the unborn; improved obstetrical and nursing care; accurate and complete registration of births; proper care of the newborn; supervision over the health of children in preschool ages and in industry; adequate facilities for baby clinics, milk depots, etc.

BUREAU OF LABORATORIES.

The establishment of a separate bureau of milk and food inspection will relieve the director of the laboratory of the responsibility of this function and permit the expansion of the laboratory along other lines. Additional equipment is needed in order to extend the scope of examinations made and physicians should be encouraged to make full use of facilities offered for diagnostic purposes. Provisions should be made for more extensive bacteriological examinations of the milk supply as a check on its sanitary quality. The importance of maintaining constant check on the purity of the city water supply has been previously emphasized.

A proposal has been made to the city by the authorities of the university medical school to establish a joint laboratory to meet all the needs of the health department and the university. Such an arrangement may prove of mutual advantage, but it is desired to emphasize the fact that any division of authority over the control of the operation of the laboratory would decrease its usefulness and value to the health department. A joint laboratory would prove an economic investment for the university and the trained personnel could be utilized for teaching purposes, but the director and his assistants engaged in health department work should be placed entirely under the direction and control of the director of health.

BUREAU OF MILK AND FOOD INSPECTION.

Although organized as a separate bureau, it is placed under the direction of the sanitary engineer for the present. The personnel indicated should be ample for very effective control over milk and foodstuffs. Dairy inspection should be extended and better control established over the methods of production and handling of milk and milk products. Pasteurization of all supplies under adequate supervision should be encouraged and extended as rapidly as possible. A more rigid enforcement of the requirements for grading milk should be brought about and the sanitary quality of the milk when distributed to the consumer should be constantly controlled by bacteriological examinations.

Better control should be established over the preparation and handling of other foodstuffs, particular attention being paid to public eating places.

BUREAU OF SANITARY ENGINEERING.

The services of a competent, well-trained and experienced sanitary engineer are especially needed. In addition to duties in connection with the supervision over milk and food inspection, there is urgent necessity for a careful and thorough survey of all conditions affecting the sanitary status of the city, including private water supplies and the problem of the disposal of all refuse and wastes, particularly garbage, night soil, and manure. The transfer of the responsibility of maintaining effective supervision over the storage and disposal of all wastes to the department of streets, bridges, and sewers has already been recommended.

A division of housing and sanitation should be organized and given supervision over the housing problem as it affects health and all matters relating to general sanitation and public hygiene. A complete and thorough house-to-house survey will reveal the extent and character of the conditions requiring correction and supervision.

The cooperation of the police department should be obtained to assist by the investigation and abatement of nuisances that are ordinarily referred to the health department but which have no real public health significance.

A division of mosquito eradication properly belongs in this bureau and the extent of the operations needed to suppress mosquito breeding has already been studied and a plan presented to the mayor and health department.

ALLIED HEALTH AGENCIES.

In order to systematically develop and expand health activities along all possible lines, and to centralize authority and supervision over all activities pertaining to the preservation and promotion of the public health, the support and full cooperation of all the so-called allied health agencies should be obtained. Reference is made to the associated charities, the Public Health Nursing Association, the Shelby County Tuberculosis Association, and any private or philanthropic organization whose resources may properly be expended in health work. Independent and uncoordinated effort on the part of such agencies will only interfere with the plans adopted by the health department. Properly supervised and correlated with the general health program formulated by the director of health, these various allied agencies will serve a most useful purpose and make possible a legitimate extension of health activities in general.

APPENDIX A.

ABSTRACT OF POWERS AND DUTIES OF TENNESSEE STATE BOARD OF HEALTH CONFERRED BY LEGISLATIVE ACTS.

[From Annotated Code of Tennessee, vol. 1, 1917, title 13, ch. 1.]

The State board of health is empowered to adopt rules and regulations and to have general supervision over the interests of the health and life of the citizens of the State; to study vital statistics of the State and endeavor to make intelligent and profitable use of records of sickness and death; to make sanitary investigations and inquiries respecting causes of disease, especially epidemics, the causes of deaths and the effects of employment, habits, localities, and circumstances upon the health of the people; to advise when necessary in reference to location of water supply, drainage and ventilation of public institutions, and to recommend works upon the subject of hygiene for the use of schools of the State.

The State board of health is also empowered to declare quarantine whenever the welfare of the public requires it, prescribe such rules and regulations as they may deem proper for the prevention of the introduction of yellow fever, cholera, and other epidemic diseases into the State, prepare and carry into effect such rules and regulations as will, in their judgment, with the least inconvenience to commerce and travel, prevent the spread of such diseases.

Violation by any person or willful disregard or evasion of quarantine or of any rules or regulations is made a misdemeanor, punishable, upon conviction, by a fine of not less than $500 or imprisonment in a county jail for a period of three months, one or both at the discretion of the court.

The acts of 1905, chapter 519, an act to prevent the introduction and spread of communicable diseases in the State, provided that physicians and others shall report to local health authorities all known or suspected cases of "smallpox, yellow fever, cholera, bubonic plague, typhus fever, diphtheria, membranous croup, scarlet fever, or other communicable diseases" except "and venereal disease, such as gonorrhea or syphilis."

It was made the duty of local health authorities to carry out, immediately upon the receipt by them of any notice of the existence of any of the above diseases, such rules and regulations as are prescribed by the State board of health; to inspect the house or locality where any of these diseases exist, isolating or quarantining infected persons or contacts when necessary; to placard the specific diseases mentioned and to employ the necessary quarantine guards to prevent the spread of the above-mentioned diseases.

The local health authorities are required by State law to provide food, fuel, medicine, nursing care, and other necessities for persons quarantined, these expenses to be paid by the persons so quarantined unless indigent.

Physicians in attendance upon cases of communicable diseases are required to notify the proper health authorities when premises are ready for disinfection.

Local health authorities are authorized to adopt measures for vaccination, and when necessary to vaccinate, to prevent the introduction or spread of smallpox. A penalty is provided for refusing or preventing vaccination and for false certification.

The board of education is required to exclude from school any pupil from a house where smallpox or any other communicable disease occurs.

Local health authorities are required to immediately notify the State board of health of the existence of any communicable disease in their respective jurisdictions, and in addition to submit on the first of each month a written report of all communicable diseases occurring during the preceding month.

Any person who willfully neglects or refuses to comply with any of the above provisions is guilty of a misdemeanor and subject to a prescribed fine or imprisonment.

Any person who has reason to believe himself affected with any communicable disease and who voluntarily goes upon any public street or place where people are accustomed to assemble, or enters any public conveyance or aids or assists anyone to so do, is guilty of a misdemeanor and subject to fine or imprisonment.

When any local "board of health" willfully neglects or refuses to comply with the provisions of this act in the face of actual or threatened epidemic, the State board of health is required to carry out the necessary provisions, the expenses to be borne by the respective municipality or county.

RULES AND REGULATIONS, STATE BOARD OF HEALTH, FOR THE CONTROL OF VENEREAL DISEASES, ADOPTED JUNE 23, 1919.

In accordance with these rules and regulations, syphilis, chancroid, and gonococcus infections are declared notifiable diseases.

Physicians, superintendents of hospitals and dispensaries, and others who may treat these infections are required to report to local health officers each case so treated, the reports to be held confidential.

When a case is reported by number only, the physician is held responsible for the observance of all rules and precautionary measures that shall be taken by the patient until said patient is cured or noninfective, which condition is to be reported to the local authorities. When there is sufficient evidence that the necessary precautions are not being taken, the name and address of the patient must be reported.

Provision is made for notification of any changes in physician or advisor employed by any patient, and when a patient fails to return for further treatment within seven days and no notice of change in physicians is received within said seven days, it is the duty of the physician previously consulted to report the name and address of any such patient.

It is the duty of every physician who treats a case of venereal disease to give each person so treated a circular of information and advice concerning these infections.

Parents or guardians of minors who may acquire venereal diseases are held responsible for their compliance with these regulations.

It is further provided that, whenever a prostitute is found infected with venereal disease, the premises shall be placarded unless such prostitute be removed to a hospital or other place where isolation and proper treatment can be carried out, and no infected prostitute is permitted to move from one health jurisdiction to another without first securing a removal permit from the local health officer in the first instance and an acceptance permit from the health officer at the place of contemplated residence.

The period of infectiousness shall be controlled by the local health authorities and persons affected with infectious venereal diseases shall not engage in any capacity in which their infection is likely to be borne to others.

No penalty is prescribed or punishment provided for any violation of these regulations.

POWERS AND DUTIES OF ORIGINAL BOARD OF HEALTH, CITY OF MEMPHIS, AS AUTHORIZED BY TAXING DISTRICT ACT OF 1879.

Under this act, the local Government was empowered to regulate, control, and suppress disorderly houses and houses of ill fame; to pass all laws to preserve the health of the city; to define, prevent, and remove nuisances within the city and for a distance of 1 mile outside the same; to make quarantine laws and enforce the same within 10 miles of the city, to prevent the introduction of contagious diseases into the city (1893); to establish and regulate hospitals in accordance with the present laws of the State (1873); to compel owners, tenants, or occupants of improved property to construct water closets and other sanitary appliances and connect same with water and sewer mains; to condemn as nuisances all buildings, cisterns, wells, privies, and other erections in the city which shall be found to be unhealthy (unsanitary or dangerous to persons or property) and cause same to be abated unless reconstructed at owner's expense; to provide that the city be kept in a "clean and healthy condition," each occupant to provide a suitable vessel for the storage of all refuse, which shall be removed by the public carts; to regulate wells and cisterns; to build, own, and maintain waterworks (1887); to regulate market houses and the sale of fresh meat, whether on foot or killed, and to appoint a meat inspector.

The local legislative council was empowered to issue bonds in order to build, purchase, or acquire control of a system of waterworks, and to compel owners and occupants of houses to take and use the water furnished; to levy a special sewer tax; and to levy a tax for the purpose of establishing a hospital for the treatment of communicable diseases.

POWERS AND DUTIES OF ORIGINAL BOARD OF HEALTH, CITY OF MEMPHIS, AS PRESCRIBED BY CITY ORDINANCES PRIOR TO 1909.

HEALTH OFFICER.

The health officer was required to carry out all the orders of the board and the laws of the State and ordinances of the city in relation to sanitary regulations; to make a thorough and systematic examination of the city and cause all nuisances to be abated.

He was permitted at all times "from the rising to the setting of the sun" to enter any place for investigation; to cause all stagnant waters to be drained, all privies to be cleansed and kept in good condition, and all dead animals or other noxious or unwholesome substances to be buried or removed beyond the city limits.

To carry out the foregoing, the health officer was directed to serve a written notice upon the owner, occupant, or agent, requiring the same to abate nuisances. Failure to comply was made punishable by fine for each violation, and the nuisance could be abated by the health officer and the cost recovered from the owner.

It was also the duty of the health officer to "visit and examine all sick persons" reported to him as "laboring, or supposed to be laboring, under any yellow or ship fever, smallpox, cholera, or any infectious or pestilential disease;" to cause such infected person to be removed to the "cholera, smallpox, or other hospitals, or to such other safe and proper place as he may direct," not exceeding 4 miles from the city, and cause them to be provided with suitable nurses and medical attendance "at their own expense," if able to pay; if not, at the expense of the county.

When directed by the president of the board, it was the duty of the health officer to cause a printed or written notice to be placed upon or near any house in which a person may be affected with smallpox. Defacing, altering, or mutilating any such notice is subject to fine.

The health officer was empowered to call upon the chief of police, who was required to furnish assistants, when necessary, to make a thorough and systematic examination of the city to ascertain all violations of the ordinances.

All terms and words used in the ordinances are specifically defined.

GENERAL HEALTH ORDINANCES.

The manufacture and sale of "poisonous, unwholesome, deleterious, or adulterated drugs, medicines, or foods" is prohibited.

It is required that all buildings or structures shall have adequate ventilation, light, and sewerage, and if condemned by the board of health as a nuisance the owner shall be notified to have the same reconstructed or removed.

All cisterns or wells found in an unhealthy condition must be rendered healthy or closed up, and the same are to be inspected by direction of the board of health at least once every three months.

Insanitary buildings or rooms shall not be rented for occupancy, and tenement, lodging, and boarding houses, theaters, and manufactories shall not be overcrowded, the same to be provided with adequate "privies or water-closets," which shall be kept in a "cleanly and wholesome condition" so as not to be "dangerous or detrimental to life and health."

Pure-food regulations are embodied in these ordinances, making it unlawful for any person or corporation to "manufacture for sale, produce, offer, expose, have in their possession, charge, or control for sale" within the city limits or 1 mile beyond, any adulterated, misbranded, below standard, or unwholesome article of food.

The board of health is empowered to adopt rules and regulations governing minimum standards for all classes of foodstuffs. The various terms are specifically defined and certain exceptions noted.

No foodstuffs shall be exposed to the dust or dirt of the street "unless perfectly protected by a suitable covering" authorized by the board of health.

A "permit" from the board of health is required for the manufacture or sale of any "food, drink, confectionery, or other condiments," whether single, mixed, or compound.

The use of milk or milk products obtained from cows found to be affected with tuberculosis is prohibited.

All meat intended for human consumption shall be inspected and stamped "Inspected" either by the board of health or the United States Bureau of Animal Industry.

Unwholesome or adulterated milk shall not be sold, and the conditions of unwholesomeness and adulterations are specifically defined.

The provisions of this ordinance are to be carried out by the "two meat inspectors, the two milk inspectors, and the food inspector of the board of health under the supervision of the city chemist."

Penalties for violations of the ordinance are provided.

SANITARY REGULATIONS.

Provisions are made to safeguard against the pollution of any public reservoir or any water used or destined to be used as a drink.

No domestic animal is permitted to run at large in any street or public place and no cattle, swine, sheep, goats, horses, or mules yarded within or adjacent to the built-up portions of the city without a permit of the board of health.

The slaughtering of cattle is regulated and a permit for the same required.

Any person selling or keeping for sale any fish, meats, poultry, or vegetables is prohibited from occupying or encroaching upon any portion of any street, sidewalk, or public place.

Every animal that is mad or has hydrophobia or shows symptoms thereof shall be immediately killed, and animals exposed to such infections shall be confined and observed for symptoms.

No business of tanning, skinning, scouring, or dressing of hides or leather is permitted (hereafter) without a permit of the board of health.

Stable manure is to be removed "at once" to "some proper place," and all stables, stalls, etc., shall at all times be kept in a cleanly and wholesome condition.

No person is permitted to leave in or throw into any street, place, or public water nor offensively expose or bury the body (or any part thereof) of any dead, fatally sick, or injured animal.

DISPOSAL OF SEWAGE AND OTHER WASTES.

Water-closets are not permitted to be constructed and connected with any sewer or underground passage unless provided with adequate vent for gases, etc.

All water-closets, privies, and urinals in residences shall be placed in a room not less than 5 feet in diameter, having at least one window with movable upper and lower glass sash. Adequate ventilation is required and such rooms shall not communicate directly by means of any door or opening with any sleeping or living room.

Privies and cesspools.—It is unlawful for any privy, sink, cistern, cesspool (1879), or well (1896) to be "made or rebuilt" in the city except in accordance with the regulations and pursuant to a permit from the board of health or for any privy to be built within 4 feet of the line of any lot.

An ordinance passed in 1880 provides for the appointment by the council and board of health of a "board of inspectors of vaults" who shall inspect every privy vault and water-closet, and when these shall be found in an unsanitary condition, the inspector is required to condemn the same as a nuisance and notify the owner or occupant to clean out, disinfect, and fill up the same.

The digging of privy vaults is prohibited.

When privy vaults have been closed, it is required that a "water-tight box, with handles, holding from 3 pecks to a bushel" be provided and let in under the seat; or a bucket or tub as prescribed by the board of health, or a "cement platform, raised at the edges 6 inches above the earth and sloping toward the center," may be used, and "at least once a day" the excrement in the receptacle is required to be covered with dry earth or ashes, and once every two weeks, or oftener if necessary, all of the excrement carried off at the expense of the city and removed to such places as the board of health may designate (until connections with the sewers can be made).

All privies and receptacles for excrement are placed under the supervision of the board of health, and inspection of every privy is required once each month or oftener if necessary.

Night soil.—When privy vaults are filled it is required that the receptacles for night soil be removed at the expense of the city until sewer connections can be made (1880). If the owner or occupant fails to abandon any privy vault when directed to do so it may be done by the board of health at the expense of the owner or occupant.

It is unlawful for night soil, manure, ashes, garbage, rubbish, or dirt to be flung or allowed to run or drop into or remain in any street or public place (1890), or for the contents of cesspools, privies, and vaults to become a nuisance or offensive (1897).

A permit from the board of health is required for the emptying of any vault, sink, privy, or cesspool in the city and said board is required to keep a record of all vaults, cesspools, etc., that are emptied.

The contents of privies, vaults, sinks, and cesspools may not be transported through any street except in an air-tight apparatus and under a permit from the board of health and all scavengers of manure, swill, ashes, offal, rubbish, or garbage are required to obtain such a permit.

The contents of sinks, privies, vaults, and cesspools are required to be disinfected and rendered inoffensive by the owner or occupant before their removal or exposure.

Garbage and refuse.—Every owner, tenant, lessee, or occupant of any and every building or place of business "in unsewered portions of the city" is required to provide at all times "suitable and sufficient boxes, barrels, or tubs" for receiving and holding without leakage and without being filled within 4 inches of the top thereof all ashes, rubbish, garbage, and liquid substances, the same to be kept in separate receptacles inside the property line and within 5 feet of a street, alley, or entrance, the public carts to remove and dispose only the kitchen and domestic household wastes, including ashes, all other refuse, including stable manure, to be removed by the owner or occupant.

COMMUNICABLE DISEASES.

Every physician is required to report immediately to the board of health "in person or in writing" any person he may attend or be called to see (within the city limits or 1 mile outside) who is sick with or whom he has reason to suspect has either of the following-named contagious diseases: Cholera, smallpox, yellow fever, scarlet fever, diphtheria, pseudomembranous croup (varicella), or chicken pox, typhoid fever, and tuberculosis, giving name, color, age, and place of residence.

In the absence of a physician, the parent, guardian, employer, or head of the household is required to make the report.

The death or convalescence of any such sick person is also required to be reported to the board of health immediately by the attending physician or by the person first making the report, giving the cause of death, at which time the health officer will remove the placard and fumigate or disinfect the house or room with contents (1887).

All persons knowing of cases of any contagious disease are required to report the same to the board of health.

Chief officers and physicians on vessels and railroads are required to report any cases of sickness or infected articles occurring thereon, and keepers of boarding and lodging houses are required to report in writing within six hours any sick person admitted from any vessel or railroad. No infected person or thing may be removed from any vessel and no person or thing from any infected place or land may be brought into the city without a permit from the board of health.

No person sick with a contagious disease may be removed from one building to another within the city without a permit from the board of health.

Smallpox.—The parent, guardian, or custodian of every minor child or other person is required to have the same promptly, frequently, and effectively vaccinated so that they may not take or be liable to take smallpox, and no child is allowed to enter any school unless successfully vaccinated or unless a certificate from a good physician is presented stating that vaccination has been tried and failed (1882).

MARRIAGES, BIRTHS, AND DEATHS.

All marriages are required to be reported in writing to the board of health by the clergyman, magistrate, or other person performing the ceremony.

Every birth is required to be reported in writing over the signature of the attending physician, midwife, or other person assisting at any birth, giving the address, sex, and color, and within five days from any such birth.

Every physician or professional adviser who attends any person at a last illness or has been present by request at the death of any person, is required to submit a written report, giving the facts in each case.

No interment of the dead may be made and no undertaker or other person may assist in or allow any such interment without a permit, and all sextons and undertakers are required to register and all undertakers are required to report once each week to the board of health all bodies or persons buried or transported since the last report.

The disinterment of dead bodies is forbidden without special permission from the mayor, nor may the same be removed until 15 months after interment or when the thermometer is over 32° F. (1879).

MISDEMEANORS.

The following acts are declared misdemeanors and made punishable by fines:

To uncover sewers or make connections therewith without permission of the city engineer.

Failure of the owner or occupant of any building used for any purpose to provide at least one water-closet, connected with the public sewer, within 15 days after notification by the city engineer or mayor.

Failure to provide a suitable sink, slop stone, or hopper for the reception of waste water unless the water-closet is suited for such purposes.

To throw filthy substances on the ground.

To allow surface or rain water to enter sewers except in accordance with regulations of the city engineer.

To deposit garbage or other refuse in any sewer or connections thereto.

To use any soil pipe or sewer extension that does not extend at least 6 inches above the eaves or well.

To use improper traps or improperly ventilated water-closets.

To spit upon any sidewalk or walks in any public square or upon the floor or platform of any street car or upon the platforms of railroad stations or the floors of any railroad passenger stations within the city limits.

Every member of the "sanitary or police force" is required to report to the board of health all water-closets, slop sinks, or other appliances not complying with city ordinances, and after an inspection the said board is required to serve a written notice upon the owner or occupant specifying the action to be taken, and the owner or occupant is required to remedy the conditions specified within five days, failure to do so being declared a misdemeanor.

CITY HEALTH ORDINANCES, 1910–1919.

1910.—To provide trustees for the hospital of communicable diseases and to prescribe their duties.

To provide for the appointment of trustees of the tuberculosis hospital and to prescribe their duties.

To prevent the spread of infectious, communicable, and contagious diseases among school children: No child may attend any school while suffering from or having been recently in contact with yellow fever, scarlet fever, smallpox, chicken pox, diphtheria, whooping cough, measles, or any other communicable disease. The board of health is authorized to have inspections made of all school children by competent assistant physicians.

To regulate the practice of midwifery as a profession: No person is permitted to practice midwifery until after passing a suitable examination and complying with other requirements, an application to be made to the superintendent of health, said application to be signed by three reputable citizens certifying as to good character. Each applicant is required to exhibit sufficient knowledge of her trade and to present the outfit used in practice. A permit for a period of one year is provided at a fee of $5. Midwives are required to report to the superintendent of health all births in which they in any way assisted. Failure to comply with all requirements is a misdemeanor punishable by fines.

To require every undertaker to report to the board of health twice each week all bodies and persons received, buried, transported, or otherwise treated.

To provide a building regulation.

To provide for a board of trustees for public baths for white and colored people.

To provide for a board of trustees for visiting nurses.

1911.—To amend an ordinance providing for the reporting of communicable diseases. Physicians are required to immediately report to the board of health "in person or in writing" all cases of the following diseases: Cholera, smallpox, yellow fever, scarlet fever, diphtheria, pseudomembranous croup, varicella or chicken pox, typhoid fever, tuberculosis, measles and other communicable diseases, cerebrospinal meningitis (1911), infantile paralysis (1912), malaria (1917), syphilis (1918), gonococcus infection (1918), chancroid (1918).

It is made the duty of the health officer or sanitary police to placard the house or residence wherein such a disease is reported to exist. Deaths are also required to be reported to the board of health by the attending physician or person first making the report.

To establish a board of hospital trustees for the government and control of the Memphis City Hospital, to prescribe their duties and define their powers, terms, and compensation. (Repealed once and repassed 1912.)

1912.—To provide for additional inspection of meats, meat products, and live stock: It is unlawful for any person to sell or offer for sale any meats or meat products unless the same shall bear the stamp or tag of inspection made by the Bureau of Animal Industry, United States Department of Agriculture, or by the city health department. Provision is made for the appointment of meat inspectors and for certain fees to be collected by them.

To require the use of metal cans with metal covers as receptacles for garbage and to further provide that said cans be kept covered.

To require all persons, firms, or corporations to report to the superintendent of the health department within 24 hours any sale or gift of diphtheria antitoxin, Flexner's serum, antityphoid vaccine, or any other vaccine or serum that may hereafter be used in the treatment or prevention of transmissible diseases.

To regulate the screening of dwelling houses to prevent the entrance of mosquitoes and flies.

1913.—To regulate the method of selling fruits, berries, vegetables, and other garden products.

To regulate and prescribe the method of selling milk, cream, or buttermilk in quantities of less than 1 gallon.

1914.—To further regulate and control the operation of street railway cars for the comfort and safety of passengers.

1915.—To amend an ordinance to regulate the handling and sale of milk within the city of Memphis, passed August 19, 1910, so as to provide for the testing of cattle: The tuberculin test is required for all cattle in herds used in the production of milk for sale within the city of Memphis, the test to be performed at least once each year by a regular licensed graduate veterinarian approved and registered with the health department.

To regulate barbering and to prescribe regulations for sanitary conditions and operation of shops.

1916.—To regulate the screening of dwelling houses to prevent the entrance of mosquitoes and flies: Effective screening with 16-mesh screens required from April 1 to November 1 for all dwellings.

To prohibit the sale or offering for sale of any fruits, candies, nuts, peanuts, popcorn, wienerwursts, tamales, sandwiches, ice cream, soda water, soda pop, coca-cola, or any like or similar articles of food or drink upon the streets, alleys, or sidewalks without written permission from the chief of police.

1917.—Making it unlawful hereafter to construct any hospital for the sick or infirm within a radius of 1,000 feet of any school building.

For the prevention of vice or prostitution in hotels and public inns.

Requiring all persons engaged in the production or handling of milk for sale in the city of Memphis to be vaccinated with typhoid vaccines and to have certificates of such vaccination available for inspection.

Providing that all cases of malaria and all cases in which malaria is a contributory cause shall be reported to the department of health.

1918.—To regulate the handling and sale of food commodities and their conservation.

To prevent the spread of venereal diseases.

To better protect the public health and particularly to further prevent the introduction of venereal diseases into and the spread thereof in the city of Memphis; to define venereal diseases; to provide for the examination of suspected and reported cases and the isolation, care, and cure of persons infected

with such diseases under the authority and direction of the health department; and to provide penalties for the violation of this ordinance.

RULES FOR THE ENFORCEMENT OF PURE FOOD ORDINANCE, 1918.

The enforcement of the rules adopted for the enforcement of the pure food ordinance is made the duty of the city health department through its chemist.

Food inspectors and health officers are required to (1) collect samples of food for examination and analysis; (2) to inspect dairies and other places where milk products are handled; stockyards, abattoirs, and slaughterhouses; canning factories, confectioneries, bottling works, and other places where food is made or prepared; grocery stores, food markets, drug stores, bakeries, restaurants, hotels, and other places where food is prepared or sold.

Samples shall be seized in the presence of the dealer in triplicate, sealed and numbered, the quantity to be not less than 6 ounces or 1 pint, duplicate sealed samples to be left with the dealer if he so requests. Each sample is to be given a serial number, to be noted in the inspector's blanks.

The methods of analysis shall be those prescribed by the Association of Official Agricultural Chemists and the United States Pharmacopœia.

Whenever any dairy, slaughterhouse, bakery, or other establishment is found unclean or conducted in an insanitary manner, the inspector shall report his findings to the city chemist and also to the owner or operator of such establishment to make the necessary changes within a specified time. When so notified the owner or agent may make a written plea to the Secretary of the board of health within five days from the date of the notice asking for a hearing to give reasons why the conditions existed and why he should not comply with the order.

The mixing of substances with any food product that will lower or reduce its strength is prohibited. Adulterations by the addition of preservatives is prohibited. The use of dyes or coloring matter for the purpose of making a product appear better or of greater value is prohibited.

Raw material used in manufacture of food and drug products shall be sound, wholesome, and free from decomposition.

Misbranding or the use of false or misleading statements or devices is unlawful, and labels shall contain the words required by the food and drug act of June 30, 1906.

The construction, sanitary condition, and operation of bakeries, abattoirs, and slaughterhouses, groceries, and meat markets, drug stores, and hotels and restaurants are specifically covered in the rules adopted, and while brief and not particularly detailed, the more important conditions are noted.

REVISED MILK ORDINANCE, INCLUDING AMENDMENTS PASSED TO 1918.

An ordinance to regulate the handling and sale of milk within the city of Memphis, in force July 10, 1917.

A permit from the health department is required for the production for sale or distribution of milk, cream, or buttermilk within the city of Memphis, the application for such permit to be made in writing, and when granted are to be issued for a period of one year. Certain pertinent information is required to be included in the applications.

No permit will be issued if the records of the city health department show that the dairy, milk depot, or store in which the milk or milk product is handled, prepared, or stored is in an insanitary condition or is being operated in violation of city ordinances. If the applicant's record is not on file, an inspection must be made of the place of business to determine the suitableness of the location, condition of equipment, sanitary condition, and methods before a permit is issued.

Any permit so issued may be revoked at any time if the holder of such permit fails to comply with the requirements of the health department, and the defendant may be granted a hearing. After such revocation the permit may be reissued if the defendant complies with all requirements and manifests his intention to meet them in the future. Permits shall be posted in a conspicuous place.

It is made the duty of the health department to publish monthly in the daily newspapers of the city the names, scores, and other data of dealers in order to inform the consumers of the relative status of all dealers.

Violation of any provision of this ordinance is made a misdemeanor, punishable by a fine of not less than $5 or more than $50 for each offense, three violations within one year revoking any permit for a period of one full year from date of last violation.

The issuance of a permit is dependent upon compliance with the following rules and regulations:

Tuberculin test.—All cattle in herds used in the production of milk, cream, or buttermilk for sale within the city of Memphis must be tested with tuberculin at least once in every 12 months, the test to be made by a licensed graduate veterinarian, appointed by and registered with the health department, and the owner required to pay a fee of 50 cents per head to the health department. All animals testing healthy shall bear an official tag and a statement filed by the official veterinarian for each animal tested. All reacting cattle shall be branded with the letter "T" on the right hip and immediately isolated and the entire premises thoroughly disinfected. Animals purchased from adjoining States are to be tuberculin-tested cattle and properly tagged.

Milk depots.—A milk depot is defined as any place, house, or room where milk is received from dairies, including all ice-cream factories, and is prepared for distribution. No milk depot shall communicate directly with any living rooms, toilet, or stable where animals are kept or slaughtered, and no accumulation of rubbish, garbage, manure, or other putrefying, infectious, or bad-smelling substance shall be allowed to accumulate within 50 feet thereof. Privies shall not be located within 100 feet from cow stables and milk rooms, and shall be properly protected from flies and mosquitoes.

Dairies.—A dairy is defined as any place where cattle are kept for the production of milk. No such dairy shall be established in unsanitary surroundings, which are held to include improperly constructed barns, milk rooms, and utensils; dirty, unhealthy cattle, which may be crowded or fed distillery waste or other food forbidden by the ordinances; unclean utensils or premises; milking without first washing and drying the udders of all cows and where attendants do not wash and put on clean outer garments prior to milking; where milk is not removed from the barn to the milk room immediately after milking each cow and at once properly cooled; milk rooms and stables without impervious floors and screens are not provided; and wherever the owner refuses an inspection of his premises or to cooperate with officers of the health department.

Floors in dairies, stables, milk rooms, and milk depots are required to be smooth, free from crevices and water-tight, and of impervious construction, well-drained and ventilated. The walls, stanchions, and partitions, round-bottomed metal-fed troughs, glass windows giving 4 square feet of glass per cow, the King or muslin system of ventilation, are all required. No side sheds may be attached, and all manure must be removed at least twice daily to a pit or field at least 200 feet from the stable. Six hundred cubic feet of air space is required for each cow stabled.

The milk room shall be provided with proper light, cooling tanks, smooth tight walls and ceiling, screened between April 1 and November 1, and adequately ventilated.

A separate wash room is required where cans, bottles, and other utensils are to be cleaned and washed, dirty cans and utensils not to be taken into or kept in the milk room.

Cooling vats to be of impervious material, provided with dust-proof covers and properly drained, the water in the vats to be kept clean, sweet, and free from sediment or odor and at a temperature not above 50° F. Refrigerators and ice boxes to be metal or porcelain lined, and the milk compartment to be clean and free from odor, nothing but milk products to be stored therein.

Bottling machines to be so constructed as to be readily taken apart and cleaned and to be thoroughly cleansed daily. Drying racks to be provided on which bottles and cans can be placed inverted for drying.

Pasteurizers and separators to be constructed so that all parts may be readily cleansed and sterilized.

Water used in dairies or milk depots to be submitted to the city chemist for analysis whenever he so requests. Each dairy to have an adequate supply of pure fresh water.

All utensils, including shipping cans, bottles, dippers, measures, strainers, etc., to be free from spaces where milk may accumulate, with smooth surfaces and free from rust and at all times to be kept scrupulously clean and in good repair. Milk stored in rusty or unsuitable containers to be condemned and destroyed by the inspector as being unfit for human consumption.

Floors, walls, ceilings, and all other surfaces to be kept clean and free from dust, dry sweeping and dusting being prohibited.

Attendants to keep themselves clean and cleanly clothed while engaged in milking or handling milk. Smoking, snuffing, or chewing tobacco is forbidden while handling milk, notices to this effect to be posted by owners in each dairy or milk depot.

No person suffering from tuberculosis, venereal disease, or other communicable disease is permitted to work in any dairy or other place where milk or its products are handled. When typhoid fever, scarlet fever, diphtheria, smallpox, measles, or chicken pox occurs in the house or family of any person employed in the handling of milk, it is the duty of the owner or manager to notify the superintendent of health immediately of the fact. No person convalescent from any communicable disease is permitted to engage in the handling of milk or enter any dairy or milk depot. When any communicable disease exists as above noted the dairy, depot, or wagon shall be declared infected, together with all milk, cream, or buttermilk with which such person may have come in contact. No person convalescent from any communicable disease or who has lived in any house where such disease exists shall reengage in the handling of milk unless the health department has enforced suitable quarantine regulations and the necessary disinfection.

The removal of any bottle or other receptacle used for containing or storing milk from any dwelling wherein exists a case of communicable disease is prohibited except with the permission of the health department and after thorough disinfection.

All milk must be stored at a temperature not above 50° F., no can or bottle of milk to be completely submerged in impure water and no impure ice to come in contact with milk and milk utensils or to be used in cooling vats. Returned empty bottles and other utensils to be thoroughly cleaned and sterilized before being conveyed into the milk room.

Milk must be transported in closed receptacles and in covered wagons, properly protected from dust and sun's rays, all wagons to be kept clean and compartments where milk is kept shall be tight and opened only when necessary for its removal.

Bottling or transferring milk from one receptacle to another upon any delivery wagon or except at the dairy or milk house is prohibited.

All milk, skim milk, cream or buttermilk in quantities less than 1 gallon shall be sold in the original and unbroken packages in which it was purchased.

Milk for delivery to the consumer shall not be above 60° F.

No receptacle used as a container for any dairy product shall be used for any other purpose.

No dairy product shall be allowed to remain at any railway station, depot, or platform longer than 1 hour from its time of arrival.

No milk ticket, except metal checks, shall be used more than once.

All milk products intended for delivery or shipment into Memphis shall be shipped in a can or receptacle bearing a tag or stamp showing name of shipper and of consignee and quantity and kind thereof, and the same shall be sealed at point of shipment with wire seal which shall not be broken until received by consignee except for the inspection of an agent of the health department. No milk or its products shall be shipped into or offered for sale in Memphis from any dairy, dealer, factory or other place upon or in the vicinity of the premises from which it is shipped where exists any dangerous or insanitary condition not hereinbefore specified which in the opinion of the health department may cause or make possible the contamination of said milk product.

Grades of milk allowed.—Only the following grades of milk shall be allowed in the city of Memphis:

1. "Certified" milk or milk that is produced and handled under the supervision of the Shelby County Certified Milk Commission.

2. Grade A, raw and pasteurized: To be clarified and to contain not more than 100,000 bacteria per cubic centimeter at time of delivery to consumer. Before pasteurization such milk shall at no time contain more than 1,000,000 bacteria per cubic centimeter. The dairy producing milk for pasteurization shall maintain a sanitary score of at least 70. All dairies or creameries offering grade A raw, shall use steam in the sterilization of all milk utensils and maintain a sanitary score of at least 90.

3. Grade B, raw and pasteurized: Raw milk of this grade, shall contain not more than 500,000 bacteria per cubic centimeter; before pasteurization not more than 5,000,000 bacteria per cubic centimeter, and after pasteurization not more than 200,000 bacteria per cubic centimeter at time of delivery. The sanitary score of all dairies or creameries offering this grade for sale shall be at least 70.

Requirements for grade A milk.—Application to produce this grade shall be made in writing to the health department. Milk so graded shall be held in containers bearing a cap, label, or tag designating the grade and whether raw or pasteurized. All sanitary scores shall be made in accordance with a scoring system adopted by the health department.

Milk for this grade must be clarified by means of an efficient centrifugal clarifier. Only a clean soda solution for the washing of milk utensils is permitted and thoroughly cleaned utensils shall be sterilized effectively with live steam.

The "holding" method of pasteurization is required, the milk, skimmed milk, or cream to be uniformly heated to a temperature of 143° to 145° F. and held between these limits for at least 30 minutes, and then cooled at once to a temperature of 45° F. or less. An accurate temperature recording apparatus is required, the records of this apparatus to be accurate and made on a daily chart which shall be dated and preserved for the inspection of the agent of the health department. An automatic thermoregulator and recorder may be combined in one instrument.

Pasteurized milk, skimmed milk, or cream shall be delivered to the consumer within 24 hours after pasteurization, and no such product shall be pasteurized the second time.

GUIDE FOR SANITARY SCORING.

NOTE.—Two-thirds credit is given for "methods" and one-third for A, B, and C. When the total of items under any of headings A, B, C, or D is below 60, zero is given for all items of that heading.

A. Stables (10 points per):
    1. Well located, i. e., on high ground.
    2. Well concreted throughout.
    3. Well drained.
    4. Well lighted and ventilated.
    5. Provided with separate quarters for sick and calving cattle.
    6. Walls and ceilings clean.
    7. Floor cleaned immediately after each milking.
    8. Manure removed to a distance of 100 feet at least.
    9. Improved stanchions with rounded troughs of metal or concrete.
    10. Stalls at least 3.5 feet wide and 10 feet high.

B. Milk and washrooms (10 points per):
    1. Conveniently located to stables.
    2. Free from flies.
    3. Properly concreted.
    4. Propery drained.
    5. Properly screened from April 1 to November 1.
    6. Walls and ceilings tight and smooth.
    7. Walls and ceilings clean and free from posters, pictures, etc.
    8. Benches or work tables clean and well lighted.
    9. Floors properly kept.
    10. Water pure, fresh, abundant in washroom.

C. Premises (20 points per):
    1. Well drained.
    2. Free from rubbish and animals.
    3. Free from breeding places of flies and mosquitoes.
    4. Privies at least 100 feet from milk house.
    5. Privies protected from flies and mosquitoes April 1 to November 1.

D. Methods (10 points per):
    1. Clean, separate clothing for milkers. Milkers' hands washed and kept dry.
    2. Cows' bags and udders washed and dried; first milkings discarded.
    3. Small top milk pails used. Milk at no time kept in stables.
    4. Utensils properly washed, rinsed in boiling hot, clean water and drained. Utensils smooth and free from rust, open seams, etc.
    5. Utensils sterilized with steam and protected from dust, etc. In lieu of steam, the use of the regulation sanitary paper container is credited.
    6. Milk immediately cooled below 50° F.
    7. Milk kept cooled below 50° F,

8. Milk delivered on ice.
9. Clarified.
10. Pasteurized.

For wholesalers whose milk is eventually clarified and pasteurized, the following (*a*) and (*b*) in place of 9 and 10, shall obtain: (*a*) Cans of milk reaching destination four hours from time of last milking; (*b*) cans of milk after leaving milk house protected from sun and dust.

APPENDIX B.

MALARIA CONTROL MEASURES.

ROOM 17, COURTHOUSE,
Memphis, Tenn., April 2, 1920.

CITY HEALTH OFFICER,
Memphis, Tenn.

SIR: There is submitted herewith for your information a brief outline of equipment, personnel and cost of malaria control measures inside the city of Memphis for the present season. This outline was prepared by Associate Sanitary Engineer W. G. Stromquist, who is familiar with local mosquito conditions and has been approved by Senior Sanitary Engineer J. A. Le Prince and myself.

It is urged that the city health authorities take such steps as may be necessary for carrying out the recommendations contained in Mr. Stromquist's memorandum as soon as practicable, since the mosquito season is almost upon us and the organization of a "mosquito squad" and the cleaning of drainage ditches might well begin at once.

You will please note that Mr. Stromquist recommends the employment of a field director—the greater part of whose salary shall be paid by the Public Health Service. If this recommendation meets your approval and proper arrangements can be made for coordinating the malaria work inside Memphis with the Shelby County work I stand ready to carry out this recommendation upon notice from you.

Respectfully,

L. D. FRICKS,
Surgeon, Medical Officer in Charge.

ROOM 17, COURTHOUSE,
Memphis, Tenn., March 31, 1920.

Surg. L. D. FRICKS,
Malaria Investigation Division,
United States Public Health Service, Memphis, Tenn.

SIR: In regard to the organization of mosquito-eradication work in the city of Memphis for the season of 1920, the following recommendations are submitted:

That a foreman with 10 or 12 laborers be employed at the beginning of the season to do such ditching and clearing of old ditches and streams as may be necessary.

That two inspectors be employed to examine streams and other natural water surfaces for mosquito breeding and to direct the oiling work. These men must be reliable, industrious, active, and interested in the work.

That at least three men be employed to do the oiling. It may be found advantageous to have these men work together with a truck to keep them supplied with oil.

That a truck, of at least 1-ton capacity, be made available for the exclusive use of the mosquito-eradication forces during the mosquito season, and that a driver be employed for the truck.

That a Ford be made available for the use of the director in charge of the mosquito-control work.

That the inspection of rain-water barrels and other artificial containers be done by the sanitary inspectors, and this be made a part of their regular duties in inspection of premises.

That the possibility of using a cheaper grade of oil than black oil and kerosene, such as "gas oil," be investigated. It is believed that 5,000 gallons or more will be required during the season.

That a field director be employed to supervise the work and to coordinate the mosquito-control measures of the Memphis Health Department and those conducted by the board of health of Shelby County in the area contiguous to the city. This field director's salary shall be paid jointly by the health department of the city of Memphis and of Shelby County and also, if possible, by the United States Public Health Service. A recommendation giving details of this plan has been submitted to the health officers of the city and county.

The area to be controlled is about 21 square miles, with approximately 36 miles of streams and ditches.

A preliminary outline of the expenditure of the fund of $10,000 for malaria control by mosquito eradication is given below:

Drainage, including new ditching, clearing of old ditches and streams	$2,325
Oil inspectors	1,600
Oilers	1,675
Oil, 5,000 gallons, at 17 cents	850
Truck driver	700
Truck and Ford	1,600
Repairs and gasoline	525
Tools and supplies	250
Field director	475
Total	10,000

Respectfully,

W. G. Stromquist,
Associate Sanitary Engineer.

APPENDIX C.

PHOTOGRAPHS TAKEN IN MEMPHIS.

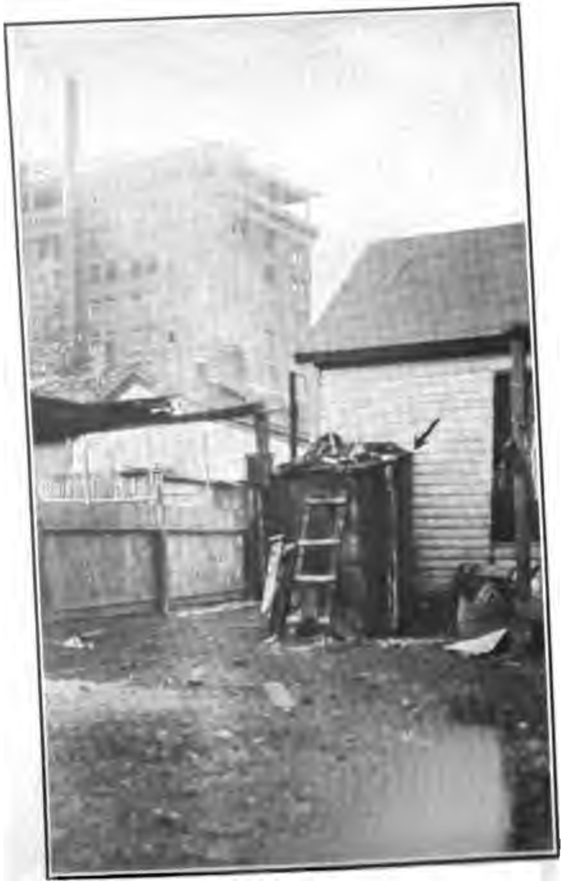

Fig. 1.—Yard closet near the Baptist Memorial Hospital. No running water. Hopper foul.

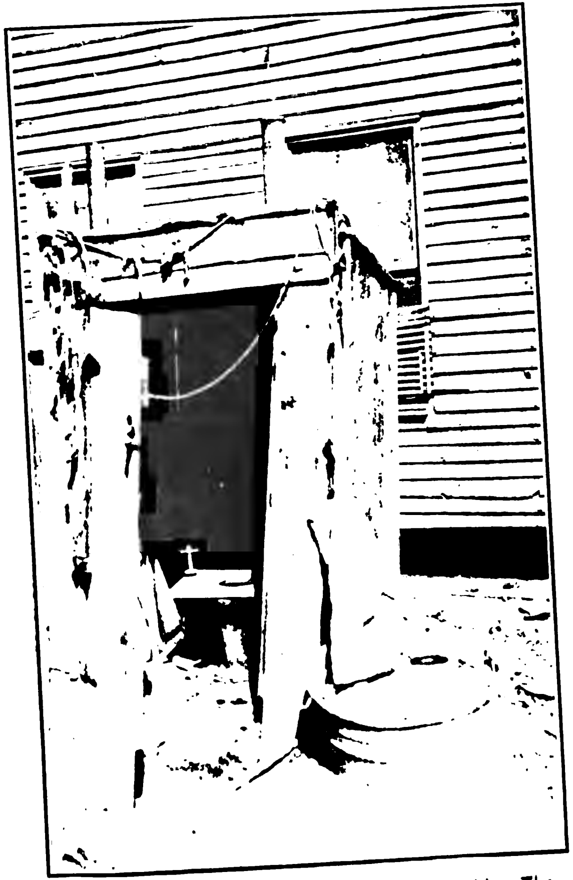

Fig. 2.—Type of "yard closet" found in Memphis. The hoppers are usually found freshly soiled with fecal matter. Superstructures are never fly-proof. They are found in practically every ward.

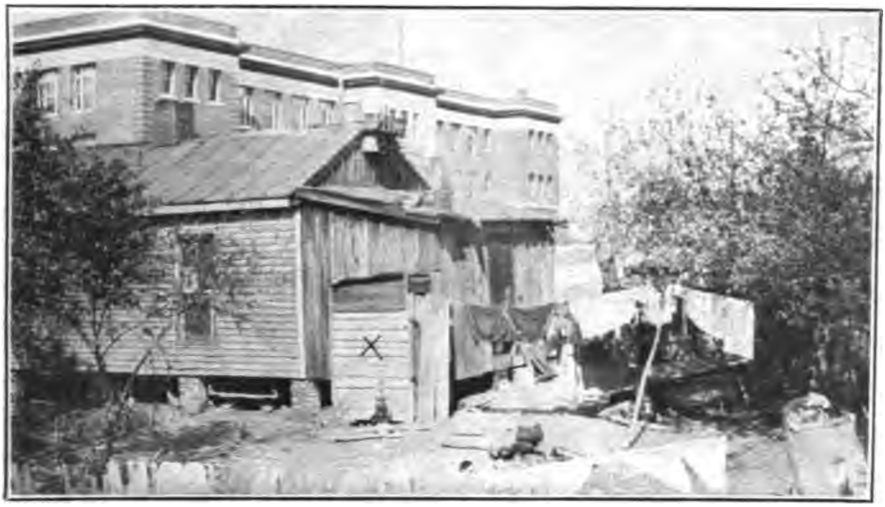

Fig. 3.—Yard closet at negro home, right in the "face and eyes" of the Bruce High School. There are several more in this location.

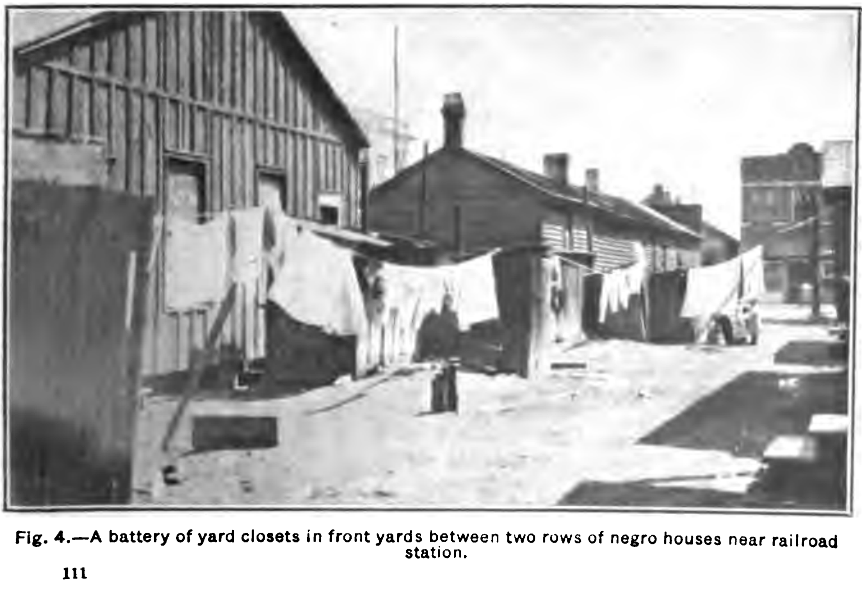

Fig. 4.—A battery of yard closets in front yards between two rows of negro houses near railroad station.

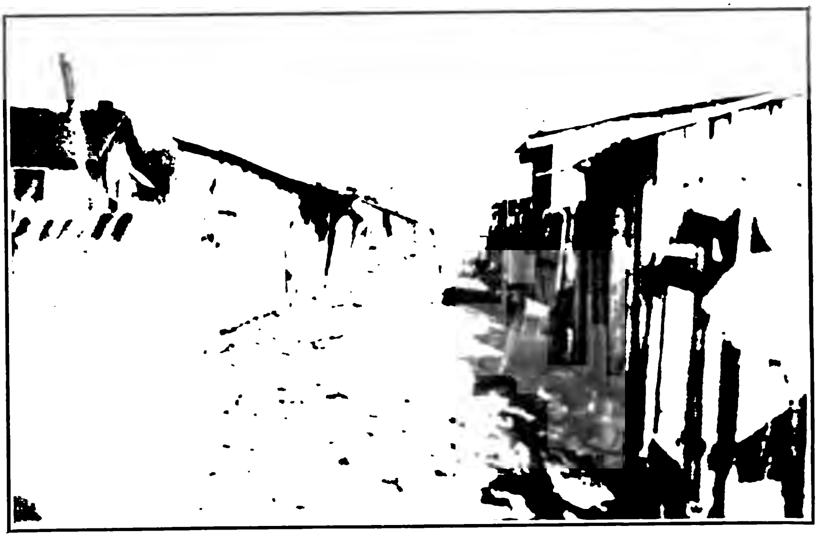

Fig. 5.—Alley with rows of insanitary privies. This alley was knee-deep with rubbish and filth of all kinds. Over 100 negro homes in this section.

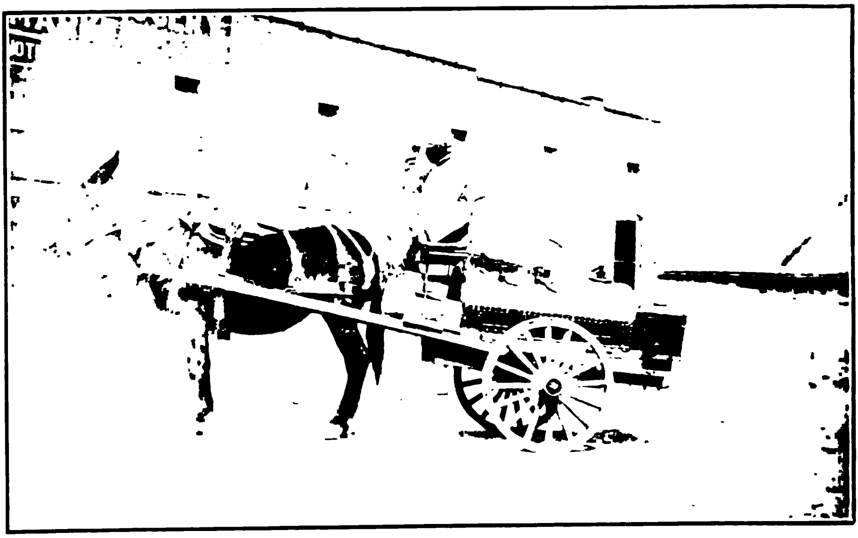

Fig. 6.—Tank wagon used for collecting privy contents.

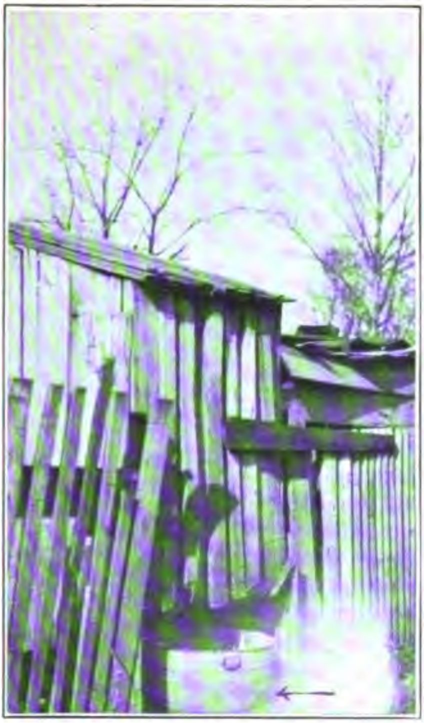

Fig. 7.—The usual type of insanitary privy—so-called "earth closet." Superstructures dilapidated, excreta freely exposed to flies, etc. Arrow points to leaking tub. These privies are a decided menace to health and pollute the private wells found in same neighborhood.

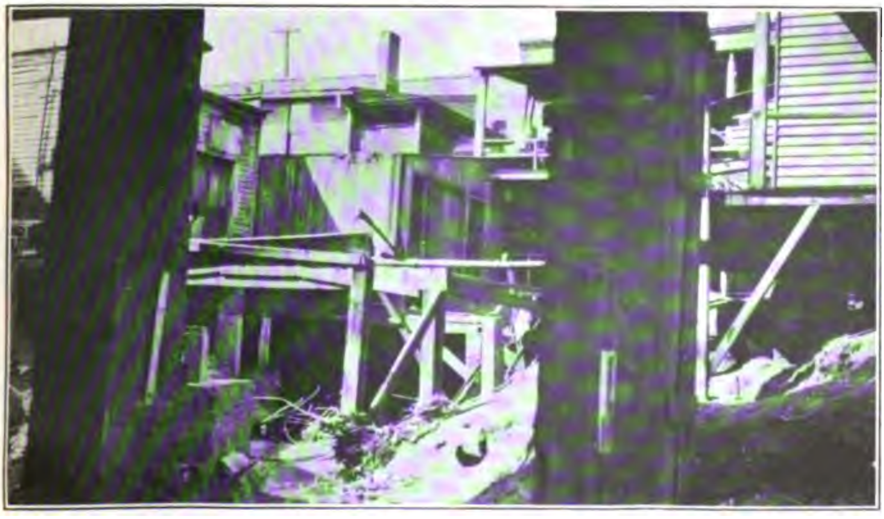

Fig. 8.—One of the "bayous," showing leaking sewer pipe. While this picture was being taken, kitchen garbage was thrown into the bayou from one of the porches.

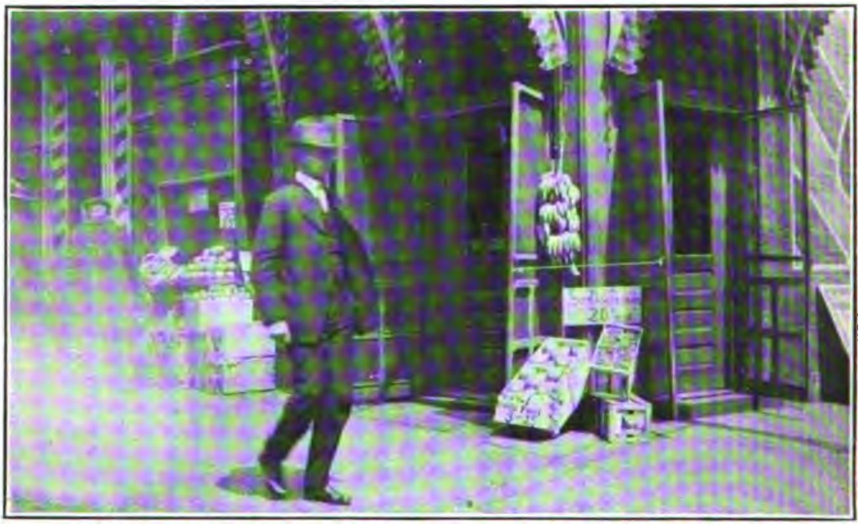

Fig. 9.—No protection of food against dirt, dust, or promiscuous handling. Food not even raised above the sidewalk.

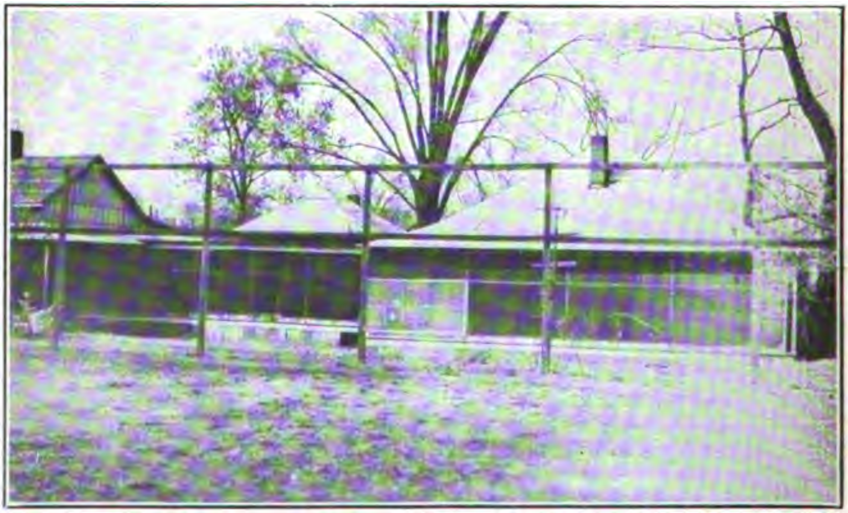

Fig. 10.—Communicable Disease Hospital. Maximum capacity 15 beds. Entirely inadequate.

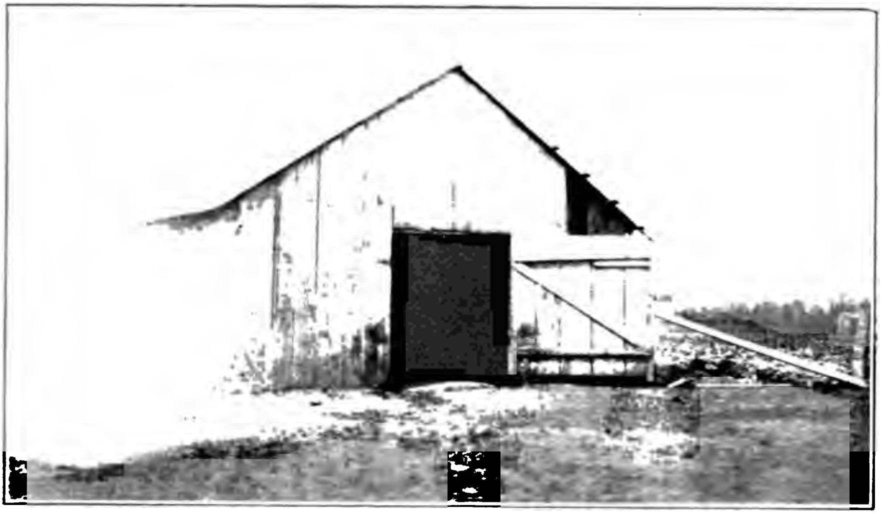

Fig. 11.—Cow stable with cement floor and plenty of ventilation. Not fancy but found clean and in good condition. Said to be of average type. Some of the others seen were given a very low rating. Methods of handling milk are more important than equipment.

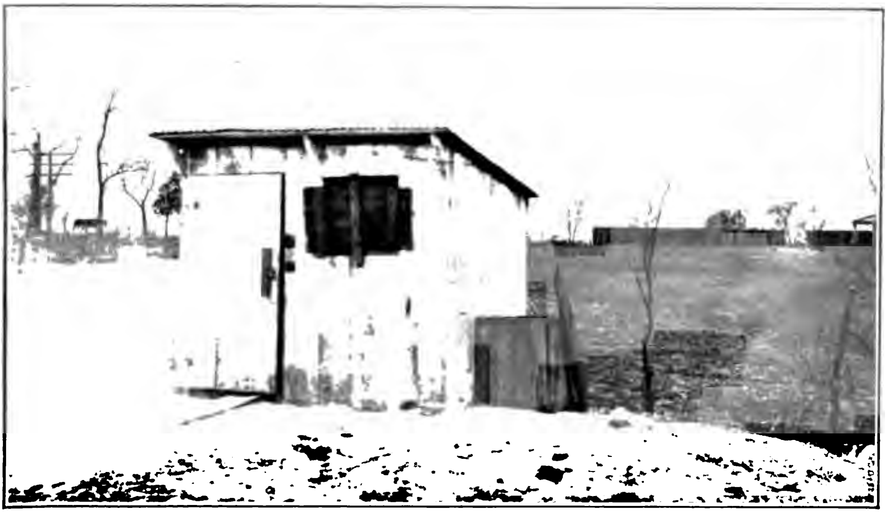

Fig. 12.—This structure is dignified by the name of "milk house." It contains a vat used for cooling milk in cans. Cooling and storage facilities are frequently crude and unsatisfactory.

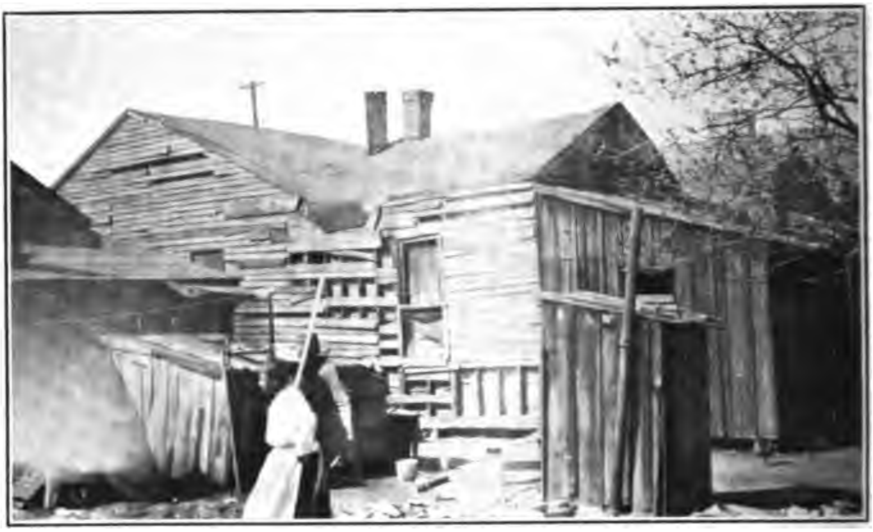

Fig. 13.—Buildings such as these should be condemned and torn down. They are unfit for human habitation.

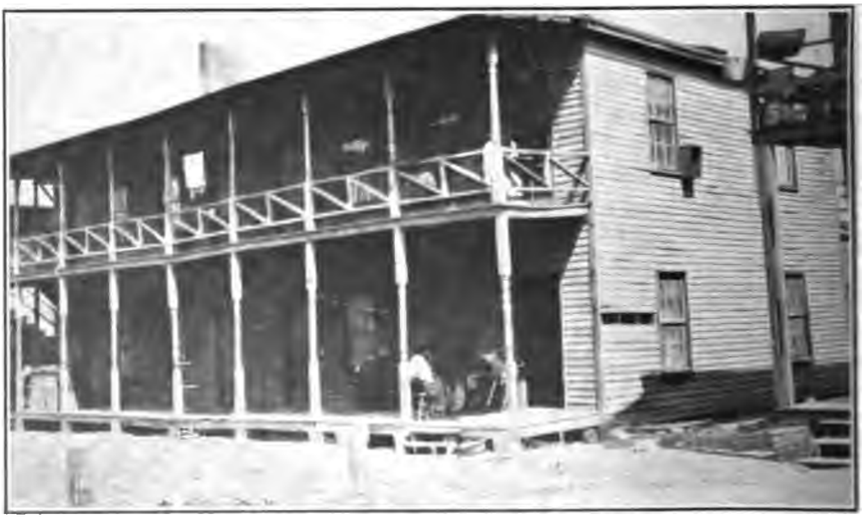

Fig. 14.—An "ark," housing many families, crowded, poorly ventilated, generally insanitary, and a nuisance; contributing to the excessive death rate among the negro population.

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 114
MAY, 1921

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TOP MINNOWS IN RELATION TO MALARIA CONTROL, WITH NOTES ON THEIR HABITS AND DISTRIBUTION

BY
SAMUEL F. HILDEBRAND
Ichthyologist, United States Bureau of Fisheries

WASHINGTON
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FOREWORD.

At the request of the Public Health Service the Bureau of Fisheries kindly cooperated with the service in carrying out studies of malaria control, by detailing Mr. Samuel F. Hildebrand to undertake studies of the relation of fishes to the control of mosquito breeding.

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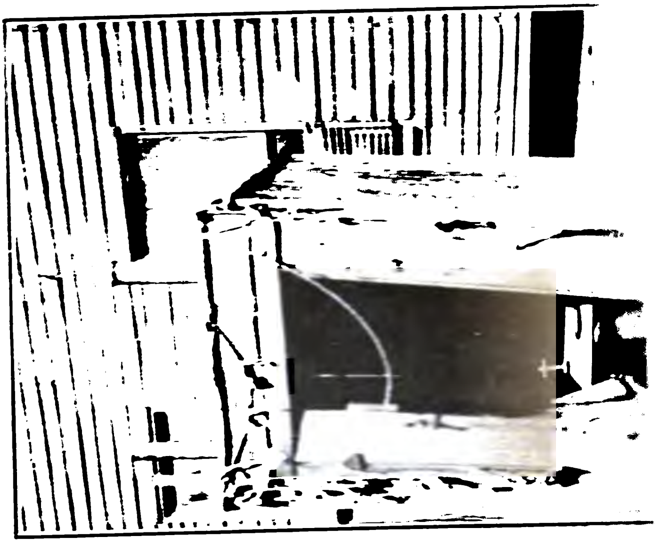

TOP MINNOWS IN RELATION TO MALARIA CONTROL WITH NOTES ON THEIR HABITS AND DISTRIBUTION.

INTRODUCTION.

The seriousness of malaria as a disease in the Southern States of this country generally has not been realized in the past, and, since it is the immediate cause of death less frequently than a number of other diseases, it has not received the attention which it justly deserves. Dr. H. R. Carter, Assistant Surgeon General, United States Public Health Service, who, because of his many years of close study and extensive experience, is well qualified to speak as an authority on the subject, says:[1] "In the United States where it seriously prevails it is the most injurious of all diseases. I do not except typhoid, nor for the South, pellagra, nor tuberculosis. * * * First, malaria is one of the diseases that debilitates and thus increases the fatality of other diseases. I am very sure it is a factor in many deaths in which it is not the terminal factor. I think it causes many more deaths than are ascribed to it. Nor is the number of deaths a fair criterion, a fair measure, of the damage that a disease does. Surely the disability that it causes, the loss of efficiency, is of importance. * * * And it is the amount of malaria that appals. There is so much of it where it exists. If you have half of 1 per cent typhoid cases in a city in a year, you count it as an epidemic, or a serious problem. Five per thousand; certainly that is serious. We scarcely consider malaria to prevail unless we have at least 10 to 12 per cent of cases a year; 25 per cent is common and 50 per cent is not rare, and at times we find 90 to 100 per cent. * * * Prosperity is not compatible with the prevalence of malaria. That is true of few diseases. Take yellow fever. I would by no means belittle the damage it does, but it does not do the harm to the community that malaria does. Habana was a prosperous city with endemic yellow fever. New Orleans was prosperous with many epidemics. But I defy you to show me one single place inhabited by white people where malaria seriously prevails which is prosperous. It does not exist."

The human suffering, the loss of life as well as the financial loss due to malaria, however, are becoming better understood and very commendable efforts are now being made by various communities in several Southern States to control malaria. Health officers are devoting much attention to methods of malaria control. The old and well-established methods of screening houses, the draining of water deposits, and the application of oil on potential mosquito-breeding areas are still extensively used, and recently malaria control by the use of top minnows for destroying the immature mosquito has received considerable attention. It is the purpose of this paper to report the results obtained by the use of minnows as an agent in the control of malaria and to show how and when this method of control may be used.

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[1] Public Health Bulletin, U. S. Public Health Service, No. 105, 1920, pp. 40 and 41.

The results hereafter recorded are based upon observations and experiments made mostly during the summer of 1920 by the writer working in cooperation with the United States Public Health Service, and in a few instances, reports, received from sanitary engineers who employed minnows for mosquito control, are quoted.

The period from March 4 to August 15, 1920, was spent mostly in inspecting various localities in 11 Southern States where active antimalaria work was under consideration or already under way. Suggestions were given to those in charge of antimalaria projects for the use of top minnows in their respective territories. Those water deposits which appeared suitable for fish control were pointed out, and an endeavor was made to find a supply of minnows locally. Usually a body of water suitable for propagating top minnows was selected in each locality and designated a "hatchery." The latter part of the season, viz, from August 15 to November 13, was devoted almost exclusively to investigations at Savannah, Ga.[2]

SPECIES OF FISHES CONSIDERED.

Experiments and observations made to date indicate that at least the following four species of fishes inhabiting the Southern States, or some portion thereof, are of more or less value in eradicating mosquito larvæ and pupæ: *Gambusia affinis*, *Heterandria formosa*, *Fundulus notti*, and *Fundulus notatus*. A fifth species, *Mollienesia latipinna* which is of no value in antimalaria work, but which has much in common with *Gambusia affinis* with respect to its habits and general appearance, at least when seen in the water, and which has not always been distinguished from the very valuable *Gambusia affinis* by field men, will also be discussed.

CHARACTERIZATION OF THE SPECIES.

All of the species of fishes mentioned in the preceding paragraph belong to the minnow family *Pœciliidæ*, which is characterized principally by the elongate body, which is depressed or flattened anteriorly and compressed posteriorly; the lateral line is absent; the mouth is terminal and capable of being projected; only one dorsal fin composed of soft rays is present; the ventral fins (the fins corresponding to the hind legs of higher animals) are inserted on the abdomen, and the caudal or tail fin is square or convex, never forked.

---

[2] I am greatly indebted to many officers, Federal, State, county, and municipal, for favors and courtesies received, and especially to Drs. Brunner and Bassett of the city health department of Savannah, Ga., for laboratory facilities and other conveniences which they placed at my disposal.

The following key gives the principal characters by which the species discussed in this paper may be recognized.

a. Top of head plain, without greenish or yellowish spot or "star;" body rather short and plump; species viviparous, i. e., giving birth to live young; males much smaller than females; anal fin of adult male developed into a long process which is used as an intromittent organ.

b. Color plain grayish silvery, the sides without dark lines along the rows of scales; caudal fin usually with vertical series of dark spots; gravid females with a black spot on abdomen above and in advance of vent; alimentary canal without convolutions, shorter than body; dorsal fin small, with 7 to 9 rays; females reaching a length of about 60 millimeters (2⅜ inches).

Gambusia affinis.

bb. Color grayish silvery, each scale on side (except in very young) with a dark spot, forming longitudinal dark stripes along the rows of scales; caudal fin plain, usually without dark spots; gravid females never with black spot on abdomen; alimentary canal greatly convoluted, about 3 times the total length of the fish; dorsal fin large, greatly elevated in adult males, consisting of 13 to 16 rays; females reaching a length of 76 millimeters (3 inches).

Mollienesia latipinna.

bbb. Color grayish green; sides with a black lateral stripe and with about eight narrow vertical bars; caudal fin plain; dorsal and anal fins in females each with a prominent black spot at base, dark spot on base of anal wanting in males; gravid females with a small elongated black spot on abdomen above and in advance of vent; alimentary canal not convoluted, shorter than body; dorsal fin small, with 7 or 8 rays; females reaching a length of 30 millimeters (1¼ inches).

Heterandria formosa.

aa. Top of head with a greenish or yellowish spot or "star" (this "star" is very evident when the fish is seen in the water); body quite elongate; species oviparous, i. e., the eggs are laid, fertilized, and hatched outside the body; the male not notably smaller than the female; anal fin of the male normally developed.

c. Sides with about 6 narrow longitudinal dark stripes and with about 12 narrow vertical bars; a dark bar on cheek under eye; fins all plain, unspotted.

Fundulus nottii.

cc. Sides with a broad longitudinal dark band, more or less broken up into blotches in young; dorsal, caudal, and anal fins dotted with black.

Fundulus notatus.

GAMBUSIA AFFINIS.

DISTRIBUTION.

Gambusia affinis is the most widely distributed and by far the most important fish known for mosquito control. It inhabits all of the southern States east of the Rocky Mountains and its range of distribution extends northward to Delaware and southern Illinois and Indiana. It was readily found in nearly all localities visited where antimalaria work was carried on during the summer of 1920. It, however, is principally a lowland species, and, in general, its distribution is limited to the malarious sections. The vicinity of Austin, Tex., for example, may be considered outside of the malarious belt of Texas, and while a limited number of apparently suitable waters occur there only a very few individuals were found after a thorough search made by a representative of the Texas State Board of Health. A similar situation prevails in Atlanta, Ga., and apparently also at Nashville, Tenn. The lower sections, or the malarious belts of the States in which the above-mentioned cities are situated, as well as those of all other southern States, as far as observed, are well supplied with *Gambusia affinis*, the species having reached nearly all sluggish and standing waters which were accessible to it through natural channels. However, there are bodies of water, artificial and others, which are inaccessible to the fish, and such waters are usually prolific producers of mosquitoes.

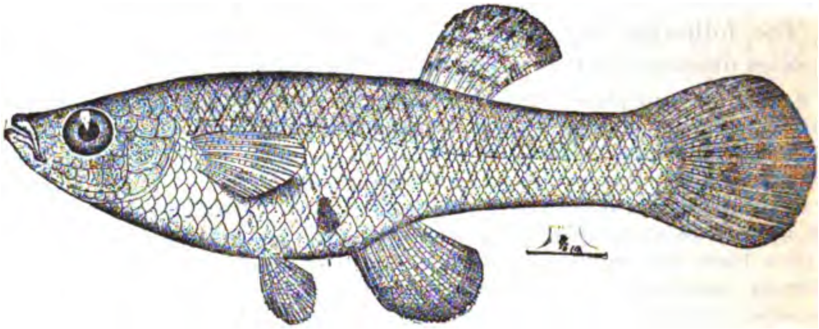

FIG. 1.—*Gambusia affinis* (female).

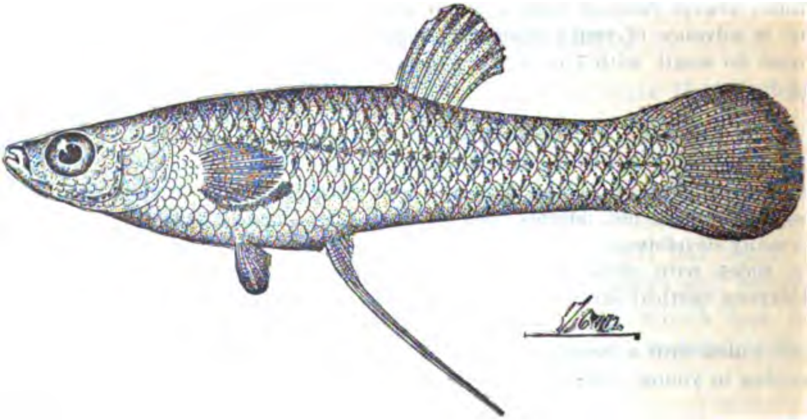

FIG. 2.—*Gambusia affinis* (male).

HABITAT.

It is improbable, regardless of being limited in its distribution principally to the lowlands, that any other American fish lives under a wider range of conditions than *Gambusia affinis*. It inhabits all kinds of sluggish and standing water, whether fresh or brackish, whether clear or muddy, whether deep or shallow. This fish, although frequenting deep water, at least when large fish are not present, shows a distinct preference for shallow water, and it is frequently seen in water too shallow to completely cover its body. This shallow water during the summer often becomes uncomfortably warm to the human touch. The top minnow probably seeks the shallow waters partly because of its fear of larger fish and undoubtedly also because the quiet, shallow places produce more food of the kind sought by *Gambusia*. It thrives in ponds visited by cattle, horses, and hogs, also in weak to moderately strong sewerage, escaping from city mains; it is found alike in open water and in that which is overgrown by vegetation, and it even withstands a small amount of chemical pollution. *Gambusia affinis* survived in ditches, at Savannah, Ga., receiving the wastes from a " guano " factory which killed such hardy species as the common fresh-water eel, the mudfish or bowfin, and the catfishes. *Gambusia*, however, endures less chemical pollution, particularly acid, than such species of mosquitoes as *Anopheles crucians*, *Aëdes sollicitans*, and *Culex* (species undetermined).[3] *Gambusia* has been introduced into cisterns, water tanks,[4] potholes, barrels, and aquaria, where it has lived for long periods of time.

The habitat of the fish, therefore, is such that it corresponds quite closely with that of the immature mosquito.

SPAWNING HABITS.

Gambusia affinis reproduces very rapidly. As already stated, it is viviparous. The eggs are fertilized and hatched within the body of the female, and the young are brought into the world well developed and alive, being from 8 to 10 millimeters ($\frac{3}{10}$ to $\frac{2}{5}$ inch) in length and eminently fitted to begin the destruction of mosquito larvæ immediately. The female has broods of young throughout the summer at intervals of from three to six weeks, the length of the breeding season varying with the latitude and somewhat with the weather conditions of the different years. The breeding season, for example, begins about the middle of May and ends near the middle of September at Beaufort, N. C.; at Augusta, Ga., it begins about the first of May and ends the first of October; while at Key West, Fla., breeding occurs at all seasons, although gravid females are much less numerous during the winter than during the summer.

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[3] A water sample taken at a point on a ditch at Savannah, Ga., where the pollution from the guano factory was as great as *Anopheles crucians* appears to use for breeding purposes, was tested for free acid by Dr. Bassett of the city laboratory, and it was found to contain 2.08 per cent of acidity and much iron. *Aëdes sollicitans*, however, bred where the chemical pollution was much greater. A water sample taken where the pollution had become dilute enough to support *Gambusia* contained only a trace of free acid and very little iron.

[4] It has been reported by Mr. W. E. Hardenburg, assistant sanitary engineer, U. S. Public Health Service, Bryan, Tex., and Mr. E. H. Magoon, sanitary director, International Health Board, Groveton, Tex., that *Gambusia affinis* will not live in metal tanks or cisterns nor in water taken from them.

The number of young produced at one time varies greatly, ranging from a few to a couple of hundred. The largest single brood heretofore recorded consisted of 100[5] young, but the writer recently found broods which greatly exceeded that number comprising, respectively, 120, 163, and 211 young. It is of interest to note that the females producing these very large broods all were from the same pool at Savannah, Ga., where they first attracted attention because of their large size (49, 58, and 59 milimeters (2, 2⅓, and 2⅓ inches) in length), the enormous distension of the abdomen, and the abnormally large black spot on the abdomen. The pool was connected with a sanitary sewer, but the water was not very foul. The sewer, nevertheless, insured an abundant food supply, which probably explains why the fish reached a large size and produced large broods of young. The average number of young to a brood, however, probably does not exceed 40, the number usually varying with the size of the female, i. e., a small female gives birth to a smaller brood than a large female. The young fish grow rapidly and become sexually mature in the aquarium at the age of about four months and quite probably in a shorter time under favorable conditions in their natural habitat. It is very important in estimating the rate of reproduction to know that *Gambusia affinis* reaches sexual maturity at a very early age. Aquarium experiments have given results which show that one female during a single season may have 345[6] offspring, consisting of two generations. Results obtained in propagating this fish indicate that this high rate of reproduction is maintained in ponds used for cultural purposes.

FEEDING HABITS.

Gambusia affinis, in addition to living under a wide range of conditions under which mosquitoes propagate, has the very fortunate habit for the purpose of mosquito control of seeking its food at the surface of the water, where the immature mosquito spends most of its life and to which it must come for air.

This fish shows a distinct preference for live bait, but it is not limited thereto for sustenance, as it eats small pieces of meat of all kinds, also bread and cracker crumbs, hard-boiled egg, etc. It takes these foods, when they are provided, in its natural habitat as well as in the aquarium. When such foods float at the surface, and, more especially, while they are in motion, as in sinking, they are usually eagerly attacked, but when they once reach the bottom they are generally left until other parts of the water have been thoroughly searched. The feeding experiments just mentioned show that by instinct *Gambusia* searches for food at or near the surface and on the bottom only when food is not available elsewhere.

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[5] Smith, H. M., Science, N. S., Vol. XXXVI, 1912, p. 224.

[6] Hildebrand, Samuel F., Report U. S. Commissioner of Fisheries, Appendix VI, 1917, p. 11.

The examination of stomach contents of a large number of *Gambusia* taken at Savannah, Ga., during August, September, October, and November, 1920, verified former observations, viz, that insects and insect larvæ constitute a large part of the food, but the majority of the stomachs examined contained some plant tissue, consisting mostly of algæ. The comparatively large amount of plant tissue found in several specimens precludes the probability that it was taken by accident in the capture of animal prey. It, therefore, is quite evident that *Gambusia affinis*, at least occasionally, eats plants.

The sense of smell seems to be very imperfectly developed in *Gambusia affinis* and it does not appear to be of any use whatever to the fish in its search for food. Sight, too, appears to lack high development, for it has often been observed that this fish will "nose" live prey, such as mosquito larvæ, and frequently move away from it, leaving it undisturbed. On the other hand, it is not unusual for *Gambusia* to seize a small stick floating on the water which resembles in size and shape an *Anopheles* larva, but such sticks are immediately expelled, and, so far as the writer has observed, they are never swallowed. It has also been observed that occasionally dead mosquito larvæ are taken but not swallowed. Live larvæ, when once seized, invariably are devoured. The writer, for the purpose of determining whether or not *Gambusia* preferred live or dead mosquito larvæ, introduced into the aquarium with a pipette both live and dead ones. The dead wrigglers upon being expelled from the pipette were in motion, and they therefore were seized by the fish and occasionally they were swallowed, but usually they were expelled. Sometimes they were reseized and reexpelled three and four times and not devoured as long as live larvæ were available.

Gambusia, as already indicated, is attracted by movements in the water, which it appears to be able to detect very quickly, but its range of vision in this respect for mosquito larvæ appears to be limited to a radius of about four or five inches. The movement of large prey is more quickly noticed than that of small prey. The wiggling of a large mosquito larva, for example, is noticed more readily than that of a small one, and this almost invariably results in the destruction of the large larvæ first. The instinct of following and capturing moving or wiggling animals is possessed by young fish when born, for it has been demonstrated repeatedly that young just born are at once attracted by the movements of wiggle tails, exactly as is the adult. The ability of *Gambusia affinis* to readily detect moving objects in the water constitutes the most important faculty of sense possessed by this fish, as it thereby obtains most of its food and also gains at least a measure of protection from enemies. It of course is this sense of motion, together with the ability of capturing moving animals in the water, which makes *Gambusia* a real enemy of the wiggle tail.

On the other hand, it is quite certain that the immature mosquito, particularly the larva of *Anopheles*, is aware of the dangers of wiggling in the presence of fish. It has been noticed many times that mosquito larvæ remain very quiet when minnows are near and when a slight movement would mean certain death.[7] The immature mosquito even appears to have acquired a very definite sense of the proper time to make a move. When placed in open water, where minnows are present, an *Anopheles* larva very rarely makes any movement whatever, but if a hiding place from fish is near it makes a surprisingly rapid dash for the place of protection at the critical moment when no fish is very near or between it and the object which it desires to reach.

Gambusia affinis has a large capacity for food consumption, as it is not unusual for one fish in the aquarium to eat over 100 large mosquito larvæ in one day. The number of mosquito larvæ which one fish may consume at one time, of course, bears a direct relation to the size of the fish, as well as the size of the larvæ. A small minnow obviously is able to consume fewer larvæ of the same size than a large minnow. Recently a large female, 59 millimeters (2¼ inches) long, which had been fed with wiggle tails rather regularly from day to day for several weeks, took within an hour 225 large immature mosquitoes, about one-third of which were pupæ. A large male, 30 millimeters (1¼ inches) long, held under the same conditions, consumed only 28 larvæ and pupæ, while fish three months old and 18 millimeters (¾ inch long) ate 4 wiggle tails, the pupæ being too large for fish of this size to swallow. The appetite of young fish just born is satisfied by one small to medium-sized wiggle tail. Young *Gambusia* frequently attack wiggle tails nearly half as long as the fish themselves. Much difficulty, of course, is encountered in swallowing a morsel of such prodigious size, a portion of the larva frequently projecting from the fish's mouth for several minutes after the swallowing process is begun.

Much greed often is displayed by *Gambusia* in the aquarium. When several mosquito larvæ are introduced at one time, this minnow snaps up the wiggle tails faster than it is able to swallow them and it is not unusual for the larva previously caught to escape from the mouth of the fish as it strikes for another. These feeding experiments show that *Gambusia*, of all sizes and ages, readily feed on mosquito larvæ, and they furnish the basis for an idea of the enormous destruction of immature mosquitoes which *Gambusia* may accomplish.

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[7] Hildebrand, Samuel F., Public Health Reports, U. S. Public Health Service, vol. 34, No. 21, 1919, p. 1123, or Report U. S. Commissioner of Fisheries, Appendix IX, 1919, p. 12.

FIELD EXPERIMENTS AND OBSERVATIONS.

Gambusi affinis is by far the most important natural enemy of the immature mosquito known to date. Its value as an agent in the control of the mosquito is becoming widely recognized, and it was used with success in 1920 by sanitary engineers and others in at least 10 Southern States. It was shown in the foregoing pages of this paper that the natural habitat of *Gambusia* corresponds quite closely with that of the immature mosquito in the malarious sections of the South. The distribution of the fish, however, is limited to the waters to which it has had access through natural channels and to the few other waters to which it has been recently transferred artificially. The mosquito, on the other hand, is able to reach practically all bodies of water, and because of its short life in the aquatic stages it is able to utilize for breeding purposes temporary waters which are not suited to support fish life. The value of *Gambusia* as an eradicator of mosquito larvæ, therefore, may be ascertained by the inspection of quiet waters which support top minnows and of those in the same locality which do not support top minnows for the purpose of determining which waters produce the largest number of mosquitoes. The value of *Gambusia* as an agent for the control of mosquitoes may also be demonstrated by stocking certain waters which are infested with mosquito larvæ and then results may be awaited and observed. A very convincing experiment may be made by stocking with *Gambusia* one of two similar bodies of water situated in the same locality, neither of which previously supported top minnows, both, however, being infested with mosquito larvæ. The body of water which is not stocked with fish will serve as a "control," which will furnish a fair comparison. Occasionally it is possible to demonstrate in a very convincing way the destruction of mosquito larvæ which *Gambusia affinis* accomplishes by connecting by means of a ditch one body of water which is heavily infested with mosquito larvæ with another pond supoprting top minnows. The above-mentioned experiments have been made within recent years by various representatives of State Boards of Health, the United States Public Health Service, the International Health Board, and by the United States Bureau of Fisheries. The results in all cases have been almost identical, and they leave absolutely no doubt concerning the great value of *Gambusia affinis* as an agent for the control of malaria.

The presence of small mosquito larvæ in waters inhabited by top minnows is not unusual, and their presence is considered merely as showing definitely that mosquitoes are breeding in these waters, but, unless large larvæ and pupæ also are present, no production is taking place, and mosquito control obtains. It is of record that rarely a body of water is found which apparently is well suited to support *Anopheles* larvæ but which the mosquitoes do not appear to use for breeding purposes.[8] It, however, is reasonable to assume that usually, at least, when no wiggle tails are found in a pond stocked with top minnows that the fish are providing control, and it has been learned through experiments and observations that when food for fish is scarce and good protection for the immature mosquito against fish is not available, then very frequently not even small mosquito larvæ are found in the presence of *Gambusia*.

The following observations, relative to the efficiency of *Gambusia affinis* as a factor in mosquito control are a few of the many similar ones made during the summer of 1920: A certain sluggish ditch at Gulfport, Miss., was inspected on May 19, 1920. The lower part of this ditch supported very few top minnows and some mosquito larvæ in protected places. Farther upstream the ditch divided. One of the branches was abundantly supplied with *Gambusia*, and not a single large mosquito larva was found. The other branch supported no fish at all, and wiggle tails were present in countless numbers. It was found upon investigation that the latter ditch received the wash from certain streets surfaced with the waste "iron pyrites" from chemical works, which so polluted the ditch that fish could not live. It is not reasonable to believe that the polluted ditch was more attractive to mosquitoes which came to deposit eggs than the unpolluted one. The fish, therefore, quite certainly provided mosquito control where they were present in sufficient numbers and where they were not hindered by pollution. On May 20 several disconnected pools and ditches were seen in the northern section of Gulfport, Miss., which were heavy producers of mosquitoes, but in not a single instance were top minnows present. The ditches in the same section which supported top minnows, however, were under perfect control. On May 24 a shallow pond on Court House Road, near Gulfport, Miss., which formerly had been connected with a drainage ditch, but which had become closed by the top of a fallen pine tree, was found to be well stocked with *Gambusia*, and no wiggle tails were present therein. The ditch beyond the pine top, where no minnows were present, was breeding *Anopheles* prolifically, the larvæ being visible in open water.

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[8] Le Prince, Joseph A., and Orenstein, A. J., Mosquito Control in Panama, p. 12. Putnam, New York and London, 1916.

Hildebrand, Samuel F., Public Health Reports, U. S. Public Health Service, vol. 34, No. 21, 1919, p. 1125, or Report U. S. Commissioner of Fisheries, Appendix IX, 1919, p. 13.

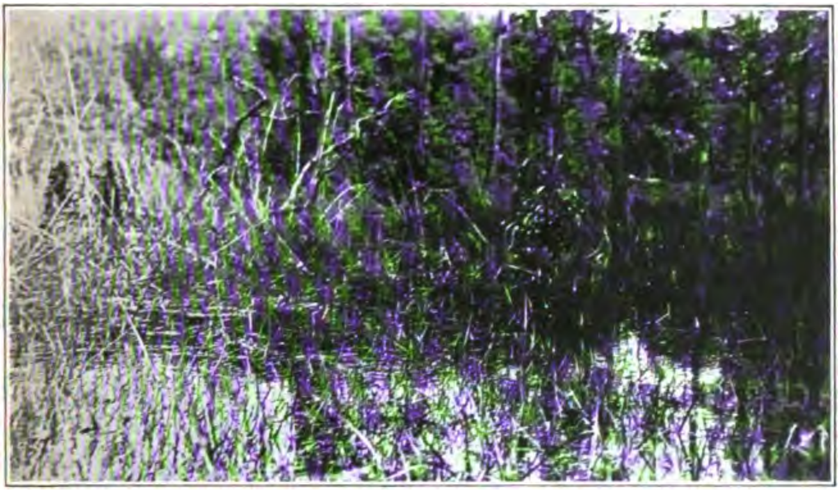

Fig. 3.—Section of pond, Gulfport, Miss., showing vegetable growth in water. Pond supports top minnows and no mosquito production was taking place at time of inspection when photograph was made, May 21.

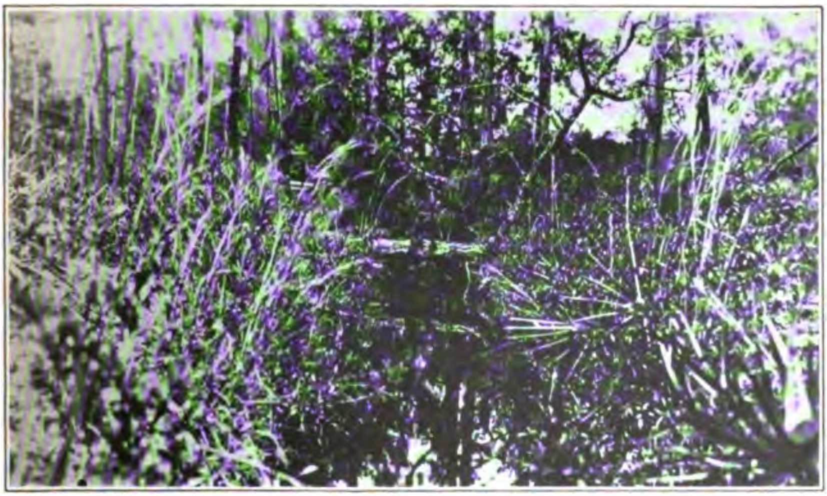

Fig. 4.—Section of ditch in pine woods, separated from pond shown in above photograph by pine top and drift. No top minnows and no vegetation in ditch, but it was a prolific producer of Anopheles at the time the inspection and photograph were made, May 21.

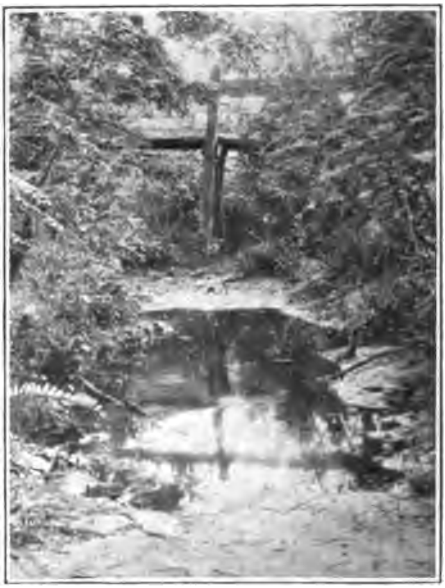

Fig. 5.—Pool left in bed of stream as water fell. No top minnows and no vegetable growth were present, but Anopheles larvae were rather plentiful when the pool was inspected and photographed, June 2. Photograph by E. H. Magoon.

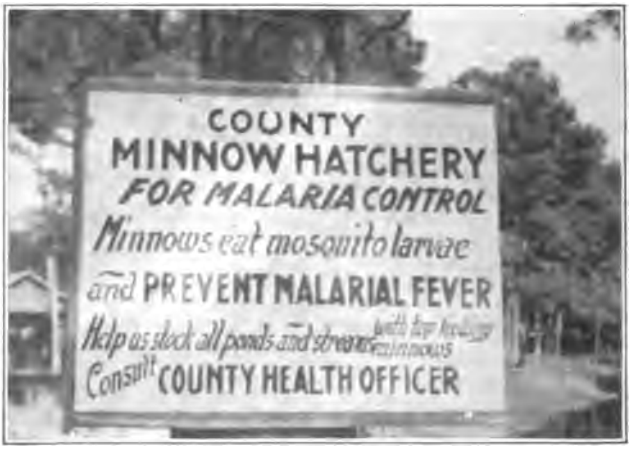
COUNTY
MINNOW HATCHERY
FOR MALARIA CONTROL
Minnows eat mosquito larvae
and PREVENT MALARIAL FEVER
Help us stock all ponds and streams with top feeding minnows
Consult COUNTY HEALTH OFFICER

Fig. 6.—Sign erected at a pond at Thomasville, Ga. Photograph by H. N. Old.

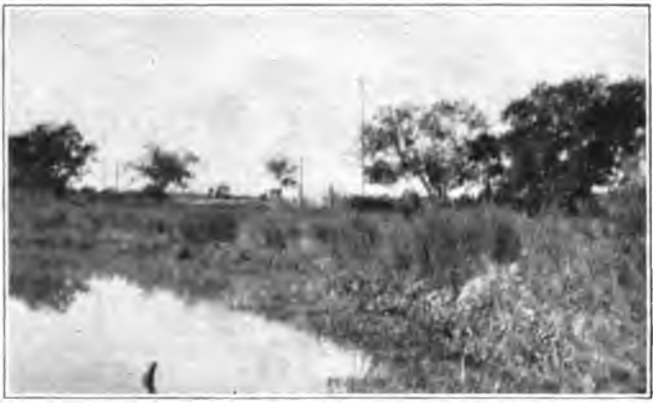

Fig. 7.—Section of pond, Augusta, Ga., abundantly stocked with Gambusia affinis, but complete mosquito control did not prevail where the aquatic grass, shown in the photograph, was present. Photographed August 5.

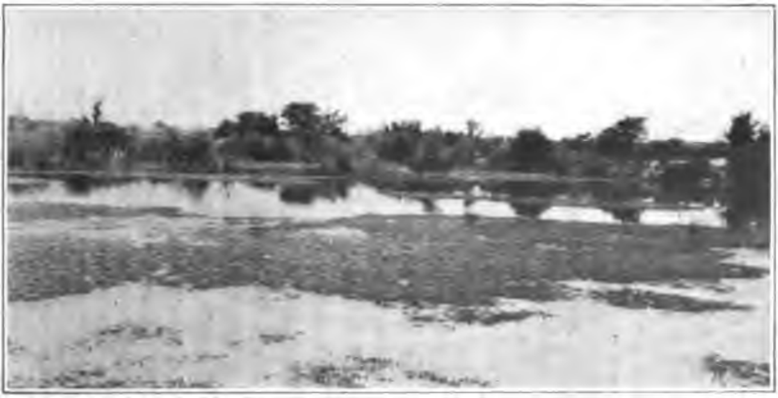

Fig. 8.—Section of pond, Augusta, Ga., showing growth of aquatic grass (Hydrochloa carolinensis) in foreground. Complete mosquito control with fish rarely prevails where this grass is present.

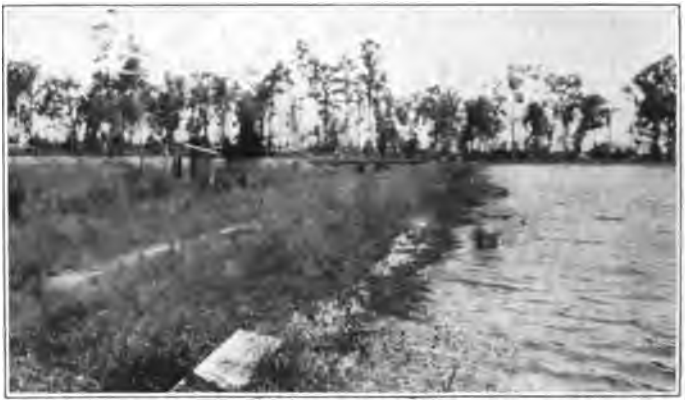

Fig. 9.—Section of sawmill pond, Perry, Fla., showing a dense growth of marginal vegetation, consisting mainly of the small dense aquatic grass (Hydrochloa carolinensis). The top minnows Gambusia affinis and Heterandria formosa were both very abundant and apparently complete mosquito control prevailed throughout the season of 1920. Photographed August 10.

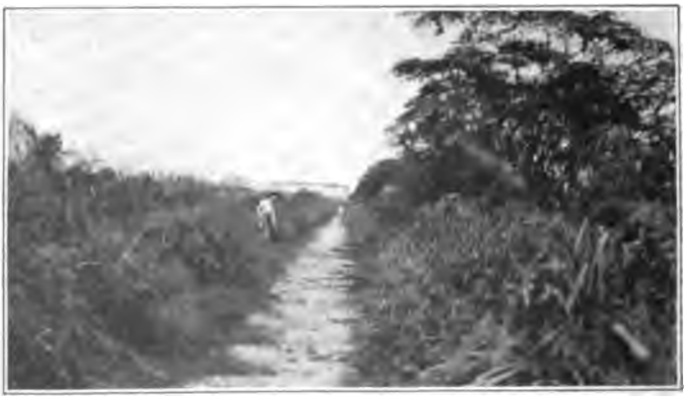

Fig. 10.—Ditch, Savannah, Ga., polluted by waste from guano factory seen in background. Vegetation consists mainly of the aquatic grass, Hydrochloa carolinensis. No fish present. A place of prolific mosquito production. Photographed October 29.

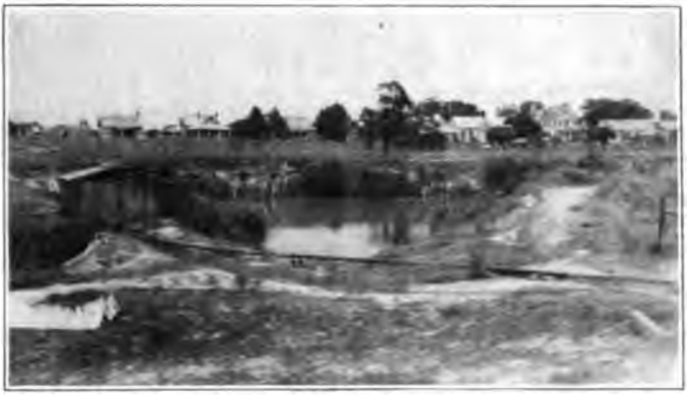

Fig. 11.—One of a series of ponds at Athens, Tex., which was used to demonstrate the reduction in malaria that may be gained by the introduction of top minnows. Photographed June 1.

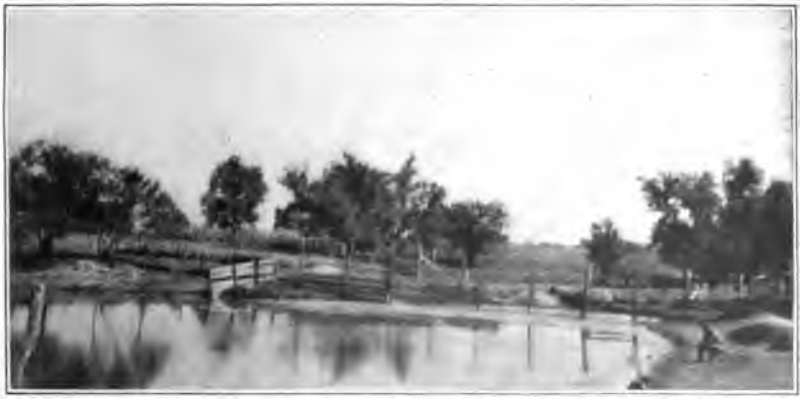

Fig. 12.—Pond in pasture, Cameron, Tex., abundantly stocked with Gambusia affinis from which minnows for distribution were obtained. Photographed June 6.

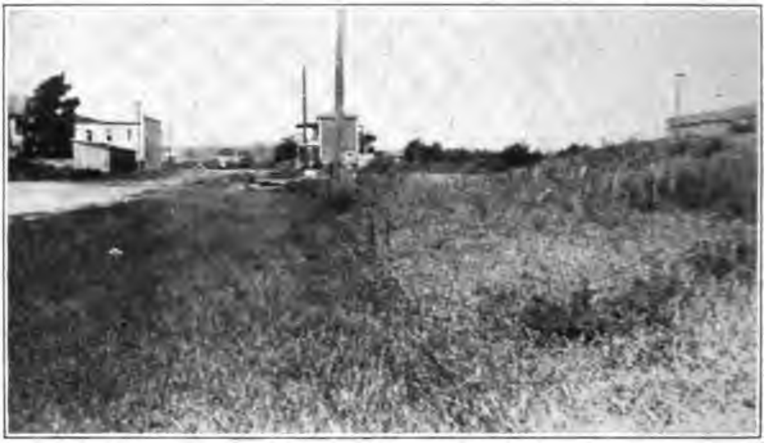

Fig. 13.—Ditch, Gulfport, Miss., overgrown with grass. Gambusia affinis abundant in water under grass. Mosquito control prevailed when inspected and photographed, May 21.

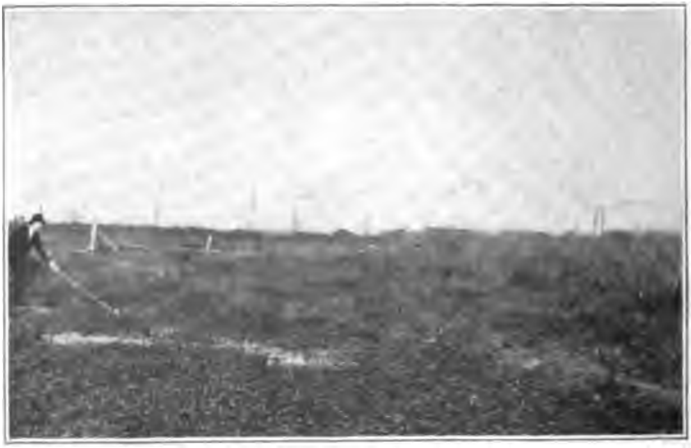

Fig. 14.—Ditch, Savannah, Ga., overgrown with primrose willows, Jussiaea diffusa and Jussiaea leptocarpa. Top minnows were abundant, but rarely was a large mosquito larva found in the dense root masses formed near the surface. Photographed October 22.

It was found on May 28, on the United States Public Health Service grounds at Houston, Tex., that top minnows were scarce in ditches on one side of a certain road, but plentiful on the opposite side. The ditches which supported few minnows bred some mosquitoes in protected places; the isolated pools which were without fish were heavy producers, but the ditches well supplied with *Gambusia* were free of mosquito larvæ. It is of interest to note that some oil had been used in the ditches nearest the hospital, and they supported few top minnows. No oil had been applied where the minnows were abundant, which indicates that even though top minnows are not killed by a film of oil, as used for mosquito control work, it nevertheless has the tendency to drive the minnows away. The oil undoubtedly is disagreeable to the fish and it destroys at least some of their food. It, therefore, does not seem practicable to use oil and fish in the same waters. It seems more advisable, when complete mosquito control does not prevail in the presence of minnows, to supply more fish or to remove vegetation and floatage, or both, rather than to resort to the application of oil as an auxiliary measure.

Two small, deep, completely isolated ponds at Athens, Tex., nearly identical in size, depth, and general appearance and situated side by side, were inspected on June 1. One of the ponds had been stocked artificially a short time previously with *Gambusia*. No mosquito larvæ were found in this pond, but they were quite common in the other one. Amusement was obtained by dipping mosquito larvæ from the latter and placing them among the minnows in the former in order to notice the quick destruction which the larvæ met in the presence of *Gambusia*. A certain creek discharging into a large sawmill pond at South Groveton, Tex., was very low, leaving only isolated pools, at the time of inspection on June 3. Certain pools in this creek bed had been left, as the water fell, without top minnows, and these pools, although usually free of vegetation and floatage, were supporting *Anopheles* larvæ. The pools in which *Gambusia* was present were all free of immature mosquitoes.

A large series of ponds at Augusta, Ga., which was stocked with *Gambusia* during the antimalaria campaign of the extra-cantonment zone of Camp Hancock in 1918[a] were inspected from August 4 to 6. It was found that no great amount of mosquito production occurred in any of the ponds and that most of them were under perfect control. A new pond on Milledgeville Road, constructed since 1918, which was not stocked with *Gambusia*, was a very prolific producer of *Anopheles.* It was not unusual to take from 25 to 100 larvæ in a single dip. It is very certain that this single pond was producing many more mosquitoes than all the other ponds in that vicinity combined.

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[a] For an account of the tests made in the extra-cantonment zone of Camp Hancock during the summer of 1918, see Fishes in Relation to Mosquito Control in Ponds, Hildebrand, Samuel F., Public Health Reports, vol. 34, No. 21, 1919, pp. 1113 to 1128, or Report U. S. Commissioner of Fisheries, Appendix IX, 1919, 15 pp., 3 figs., 6 pls.

The natural distribution of top minnows at Savannah, Ga., owing to the low and flat nature of the land, is quite thorough, practically all ditches and swamps being stocked. A few ponds or swamps, because of artificial barriers, had not been reached by fish. Such places invariably were heavy producers of mosquitoes, while similar waters near at hand, but supplied with top minnows, invariably were under perfect control. When these heavy breeding areas were stocked with minnows complete mosquito control resulted in each instance within two weeks.

Certain ditches at Savannah, Ga., became polluted by acid waste from a "guano factory" during October, due to drainage operations which caused the current in the drain receiving the waste from the factory to become reversed, discharging its contents into unpolluted ditches. A series of ditches consequently became polluted, causing, as already stated, the death of mudfish, catfish, eels, etc., and it drove away the top minnows from the more strongly polluted ones. *Gambusia*, however, remained where the pollution was very dilute. Several species of mosquitoes, including *Anopheles crucians*, as already stated, were able to withstand more pollution than top minnows, and heavy mosquito production resulted in certain sections of the ditches where the pollution was somewhat diluted, yet too strong for *Gambusia.* These ditches were under almost perfect control when top minnows were present. A rather definite line afterwards marked the place where mosquito production ceased, which was coterminal with the line beyond which top minnows were unable to live because of the pollution. It, again, does not seem reasonable that the polluted portions of the ditches offered more favorable breeding conditions for the mosquito than the very slightly or entirely unpolluted portions. Therefore it seems quite certain that the top minnows, where they were present, were the agents which supplied mosquito control.

MOLLIENESIA LATIPINNA.

Mollienesia latipinna is a larger fish than *Gambusia affinis*, the female frequently reaching a length of about 75 millimeters (3 inches). Its range of distribution is very much smaller than that for *Gambusia affinis*, being limited to the low coastal plains from South Carolina to northern Mexico. It inhabits strongly brackish and fresh water swamps and sluggish ditches and streams. *Mollienesia* is usually very abundant within its range, and it frequently is found in company with *Gambusia affinis*, from which it is distinguished in the water with difficulty because its general shape, color, and swimming movements when seen from above are very similar. The adult fish when removed from the water, however, is readily distinguished from *Gambusia affinis* by the dark lines along the rows of scales on the sides, and the dorsal fin is notably longer, as shown in the preceding section of this paper, entitled "Characterization of the Species" (p. 8).

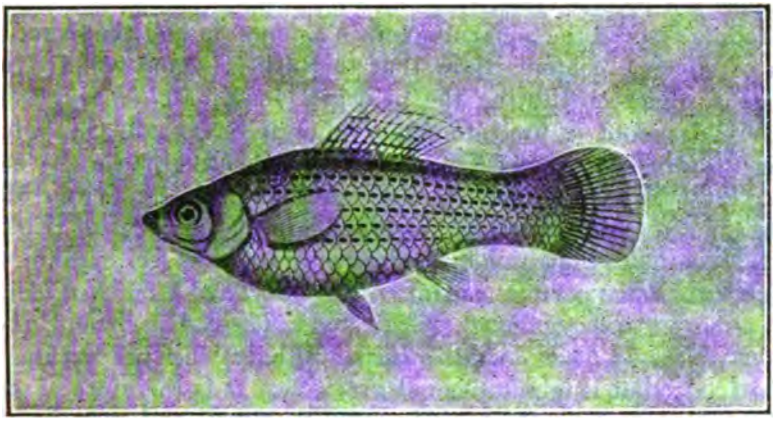

FIG. 15.—*Mollienesia latipinna* (female).

Mollienesia latipinna appears to produce broods of young with a somewhat larger numerical average than *Gambusia*, although to date the largest brood found is smaller than certain broods of the latter reported in the foregoing pages of this paper. Broods exceeding 100 in number were not unusual at Savannah, Ga., during August and September, 1920. The largest brood seen, consisting of 139 young, was produced by a female 73 millimeters long (nearly 3 inches). Aquarium experiments suggest that *Mollienesia latipinna* produces broods of young at greater intervals than *Gambusia*, but the short time devoted to these experiments was insufficient to produce definite results.

The young of *Mollienesia* at birth are notably larger than *Gambusia*, being from 11 to 12 millimeters (½ inch) in length. They grow rapidly, as certain young born August 26 had attained a length of 21 millimeters on November 8. The age and size at which this fish reaches sexual maturity is not known, but it probably does not differ greatly from *Gambusia*.

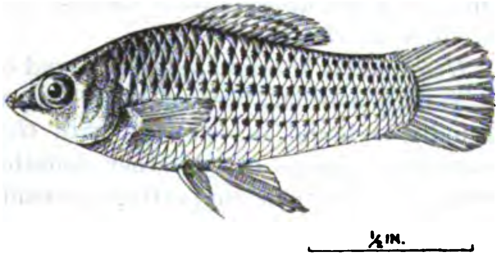

FIG. 16.—*Mollienesia latipinna* (male).

Mollienesia latipinna usually swims somewhat deeper than *Gambusia*, and the adults, at least, are seen less frequently in very shallow water. The species is much more timid and harder to catch than *Gambusia*, and, unlike the latter, it is very restless in the aquarium, and does not become tame.

Feeding tests in the aquarium and in a fountain and the examination of stomach contents show that this fish is almost wholly herbivorous, algæ constituting the principal food. *Mollienesia* is extremely abundant in the sewerage ditches at Savannah, Ga., where it feeds extensively on the organic matter delivered by the city sewers. *Mollienesia* did not feed on wiggle tails in the aquarium when green algæ, too, was supplied. It failed, after several weeks' trial, to provide mosquito control in a fountain only about 12 feet in diameter, which was under perfect control within two days after *Mollienesia* was removed and *Gambusia* substituted. These experiments show that *Mollienesia* feeds on mosquito larvæ only when its natural or usual food (that is, plants) is not available. It is therefore of very little value as an eradicator of mosquito larvæ, and may be disregarded in practical mosquito control work.

HETERANDRIA FORMOSA.

Heterandria formosa is probably the smallest American vertebrate.[10] The largest female seen, which was an exceptionally large fish of its kind, measured 31 millimeters (1¼ inches), in length, while the males rarely exceed a length of 20 millimeters (¾ inch).

The range of distribution of this species is given in current works as extending from North or South Carolina to Florida. The Florida records, however, appear to be confined to the Atlantic drainage. The author recently found this fish in abundance at Perry, Taylor County, Fla., about 20 miles inland from the coast of the Gulf of Mexico, which appears to be the first time that this species was taken in the Gulf drainage.

Heterandria formosa has been found only in low coastal plains, but it runs somewhat farther inland than *Mollienesia latipinna* and usually is found in company with *Gambusia affinis*. Its habitat, however, appears to be rather definitely restricted to fresh-water swamps and ditches supporting a considerable amount of vegetation, among which it lives, seeks its food, and gains a measure of protection from enemies. *Heterandria* is easily overlooked, even where it is abundant, because of its small size, because it is seen at the surface less frequently than *Gambusia*, and because of its habit of usually remaining among vegetation.

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[10] Henn, Arthur W., American Naturalist, vol. 46, March, 1912, p. 161.

Heterandria formosa is an excellent aquarium fish. It is even more hardy than *Gambusia*, it has beautiful color markings, and it becomes tame very quickly. It may be taught, in a very short time, that taps on some portion of the aquarium indicate that food is to be provided at that point. A large pipette was used for introducing mosquito larvæ in the aquaria, and the fish very quickly learned to respond to taps and to take a position at the mouth of the pipette where they eagerly awaited the expulsion of larvæ. The wiggle tails were instantly seized upon being liberated and the introduction of other larvæ was anxiously awaited until the fishes' appetites became satisfied.

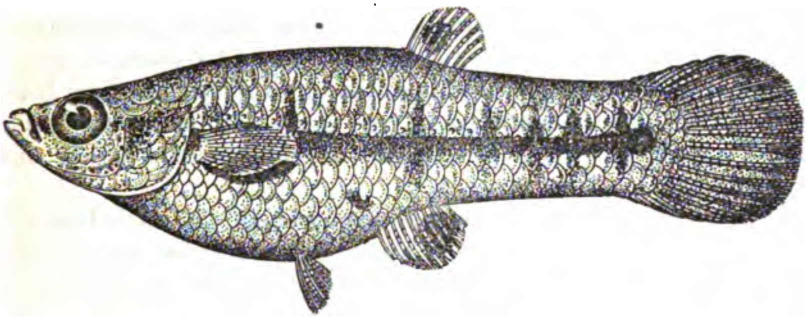
FIG. 17.—*Heterandria formosa* (female).

This species produces small broods of young, which consist of from two to nine fish, but new broods appear at frequent intervals. Females confined in aquarium jars in the city laboratory at Savannah, Ga., on August 25, 1920, had young at intervals varying from one to three weeks, until about the middle of October, when the spawning season ended. The ovary of this fish, during the breeding season, contains embryos of three or four distinct sizes. One lot of embryos, for example, may consist of fully developed fish which are about ready to begin an existence separate from the mother; another lot is notably smaller, and the embryos have a considerable amount of unabsorbed yolk; the third lot consists of small embryos which are still within the egg case; and the fourth lot consists of "eyed" eggs. At least two sizes of eggs, in addition to the embryos, are present within the ovary during the breeding season.

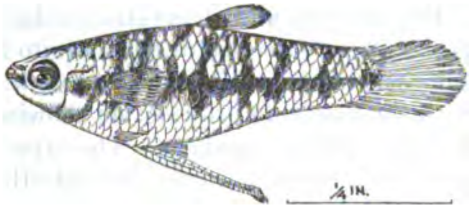

FIG. 18.—*Heterandria formosa* (male).

The young when born are well formed and active, but they are very much smaller than the newly born *Gambusia*, being only about 6 millimeters (¼ inch) in length. Young born in the aquarium on September 4 and fed rather regularly on a diet of bread crumbs and mosquito larvæ had attained a length of only 10 millimeters ($\frac{3}{8}$ inch) on November 8, when they were no larger than *Gambusia* at birth.

Heterandria formosa appears to feed on quite as many different kinds of foods as *Gambusia*, and it also shows a distinct preference for a live animal diet. It attacks and eats with avidity mosquito larvæ, but even the largest females have great difficulty in swallowing the pupæ. The newly born young, like those of *Gambusia*, are attracted at once by the movements of mosquito larvæ, and they follow and attack wiggle tails nearly as large as the little fishes themselves, but, of course, the young fish are able to swallow only rather small wrigglers.

Heterandria appears to be less cannibalistic in its habits than *Gambusia*. Certain broods of young were left in rather small aquarium jars with the mothers for several months and some of the young were not destroyed, while *Gambusia* invariably destroys all of her young under similar conditions within a few days. The adult *Heterandia* is frequently attracted by the movements of the young, and it gives chase, but apparently the young fish is not destroyed, provided that the mother distinguishes between her young and a wiggle tail before the little fish is actually seized. It certainly is true, however, that many species of fish, not naturally cannabilistic or even strictly herbiverous, will resort to cannibalism when other foods are not supplied. *Mollienesia latipinna*, which is normally herbiverous and which does not destroy wiggle tails if plant foods are present, will devour her own young in the aquarium when her appetite prompts her to resort to other than her natural foods. Therefore, it is necessary to supply sufficient natural foods to satisfy the fish's appetite, if the aquarium tests are to be indicative of the fish's natural tendencies relative to cannibalism.

Experiments and observations relative to the value of *Heterandria formosa* as an eradicator of mosquito larvæ have not extended over a sufficient length of time nor over a wide enough range of conditions to furnish definite information showing its relative value as an agent for the control of malaria. The experiments and observations which have been made, however, indicate that it is of real value under at least the limited range of conditions under which the tests were made. Two somewhat similar, shallow ponds, about 30 by 20 feet each, largely overgrown with vegetation and both heavy producers of mosquitoes, were stocked with this fish during the latter part of the summer of 1920. Perfect mosquito control resulted in each instance within about two weeks, and this control was maintained until the ponds went dry in October. Neither of these ponds presented especially difficult situations, as the vegetation consisted principally of semiaquatic plants, which did not provide good protection for mosquito larvæ against fish. The low and flat nature of the land in the vicinity of Savannah, Ga., where these experiments were made, has resulted in a very general distribution of top minnows, leaving no permanent waters and only comparatively few temporary ones without fish. This situation precluded the opportunity of making tests under a wider range of conditions. Field observations in general yielded nothing very definite, because wherever *Heterandria* naturally occurred *Gambusia* also was present, and it was not possible to determine the respective parts provided by the two species in the very excellent control which generally obtained. However, it is absolutely true that not one place was seen, and many difficult conditions from the standpoint of mosquito control with fish were inspected both at Perry, Fla., and Savannah, Ga., where almost perfect mosquito control did not prevail in the presence of both species. The small size of *Heterandria formosa*, making it possible for this fish to reach places inaccessible to larger minnows, together with its habit of living among vegetation, suggest that it may constitute a very important enemy of the wiggle tail, which seeks refuge among plants. The inspections and the experiments, while not very definite or extensive, as already shown, nevertheless indicate that *Heterandria* is a very serious enemy of the immature mosquito and that this fish is well worth serious consideration as an agent for the control of malaria.

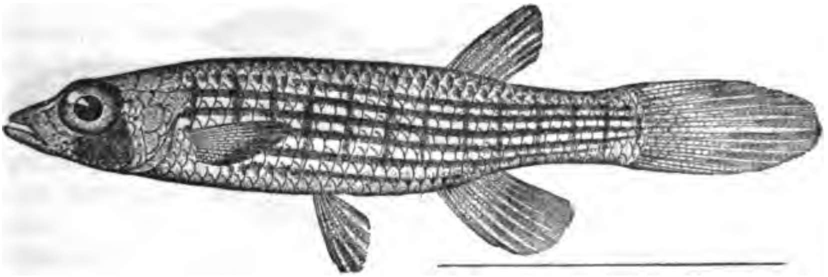

FIG. 19.—*Fundulus nottii.*

FUNDULUS NOTTII.

Fundulus nottii is known from sluggish streams and swamps from North Carolina, South Carolina, Georgia, Florida, and Alabama. It has not been seen by the writer in the low coastal plains, but it occurs somewhat farther inland. This fish is not as abundant within its range as the viviparous species discussed in this paper, and it is rather particular in its choice of locality. It appears to prefer ponds and swamps which support much vegetation, and it is not present in all waters accessible through natural channels in the regions where it occurs. It is a very timid species, difficult to catch, and does not live well in confinement.

Nothing definite is known concerning the spawning habits of this species, but, since it lives among vegetation, it is supposed that the eggs are deposited in the vegetation or possibly attached to it. No practical tests relative to the value of this species as an eradicator of mosquito larvæ have been made. The supposition that it is of value as an agent for the control of malaria is based upon its habit of swimming at the surface and living largely among vegetation and upon certain rather unsatisfactory field observations.

FUNDULUS NOTATUS.

Fundulus notatus is much more widely distributed than *Fundulus nottii*, for it ranges from Michigan to Alabama and westward to Texas. Its habits in the South appear to be identical with *F. nottii* and our knowledge of its value as an eradicator of mosquito larvæ is equally as limited. It was found to be rather common in a certain large pond at Jacksonville, Tex., where no other top minnows were present. The sanitary engineer in charge of antimalaria measures at this place reported that during the early part of the season of 1920 fairly good mosquito control prevailed in this pond, but during June mosquito larvæ appeared in such large numbers that it was thought necessary to introduce *Gambusia.*

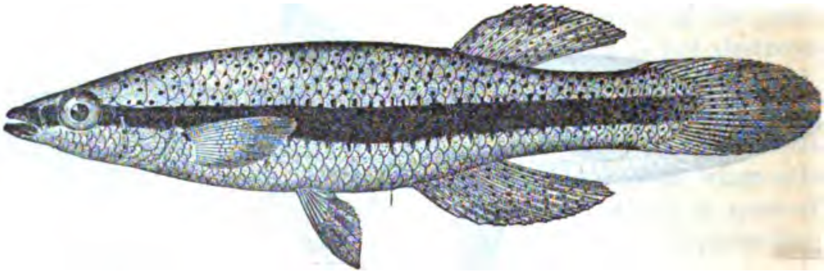

FIG. 20.—*Fundulus notatus.*

It is extremely doubtful whether it will be practicable to use these egg-laying species, except in a very limited way, for the control of malaria, as they nowhere have been found in sufficient abundance to justify the expectation of complete mosquito control, and it will probably prove difficult to propagate them in large numbers.

PROPAGATION OF MINNOWS.

It has been found advantagous in many localities, where antimalaria work was being carried on in the South in 1920 to designate particular bodies of water in which special effort was made to propagate minnows. Such ponds or "hatcheries" usually furnished a convenient supply of minnows for transplantation from time to time into waters where additional fish were required. The hatcheries also afforded means of meeting requests for minnows received from individuals who wished to control mosquito breeding in waters on their respective premises.

The requirements for successful propagation of the egg-laying species *Fundulus nottii* and *F. notatus* are not known, but they undoubtedly need special conditions of environment for depositing and hatching the eggs. Propagating the viviparous species is very much simpler, as no special conditions for spawning are necessary, the young being born as the fish moves about in the water. Only two conditions appear to be essential in a body of water for the successful propagation of *Gambusia affinis*, viz, an abundant food supply, and protection from enemies. The most important enemies of the top minnows are the larger species of predacious fishes. The water snakes and birds, too, are enemies, and not infrequently bait collectors prove to be the worst offenders of all. Therefore, it is important to choose a body of water where the enemies are not present or where they can be controlled. Bodies of water with a considerable amount of plant growth usually supply abundant food for *Gambusia*, and they have been very successfully used as "hatcheries." Ponds in pastures visited by live stock have been used with especially good success, and water deposits in open fields and pastures generally have given better results than waters in wooded areas.

Health officers in a few instances have thought it advisable to advertise the "hatcheries" in their territories for the purpose of stimulating an interest in antimalaria work which would reach beyond the particular area used for demonstration purposes. In one instance a signboard reading as follows was erected: "County minnow hatchery for malaria control. Minnows eat mosquito larvæ and prevent malaria fever. Help us stock all ponds and streams with top-feeding minnows. Consult county health officer."[11] Such signs undoubtedly serve a useful purpose in educating the public in the use of this comparatively inexpensive antimalaria measure which is available throughout the malarious sections of the South.

PLANTS AND FLOATAGE IN RELATION TO MOSQUITO CONTROL BY THE USE OF FISH.

Large mosquito larvæ and pupæ frequently are found in waters where top minnows are plentiful, but only among plants or floatage of such a character as to provide refuge for the immature mosquito against fish. *Anopheles* larvæ particularly have highly developed the habit of hovering over slightly submerged objects. A mere film of water over a leaf or over a floating piece of wood is sufficient for the welfare of a mosquito larva, while it usually is impossible for a minnow to reach an immature mosquito in such a position. Mosquito larvæ and pupæ, however, have never been found by the writer to be very abundant even where excellent protection from fish was at hand, if *Gambusia* was really plentiful. It has not been determined how many of the large larvæ and pupæ found under the conditions just described actually escape the fish permanently and attain the adult stage. It was shown through feeding experiments, already described, that the movements of large prey are more quickly noticed by the minnows than that of small prey, and that in the aquarium large larvæ and pupæ invariably are destroyed before the small larvæ are noticed. The security of the immature mosquito in the presence of top minnows therefore depends upon how quietly and closely it adheres to places of protection.

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[11] This sign was erected at a pond on the Tallahassee Road at Thomasville, Ga.

Certain ponds at Augusta, Ga., previously mentioned, furnish a good illustration of the difference in mosquito production which may be expected when top minnows are plentiful and when they are absent. A pond on the Milledgeville Road, largely overgrown with aquatic grass, and not stocked with top minnows, was breeding *Anopheles* so profusely that frequently from 25 to 100 larvæ could be taken in a single dip with an ordinary water dipper. The larvæ in this pond were not confined to the densest vegetation alone, but they could be seen and collected from the open water. Numerous other ponds in the same vicinity, which were more densely overgrown with aquatic grass, but which were stocked with *Gambusia affinis*, yielded, at most, one immature mosquito to a dip, when the dippings were made in the densest growth of grass and no larvæ were present in open water. The illustrations just cited probably are typical and it shows the results which may be expected, even under adverse conditions, from the use of top minnows for mosquito control.

Plants with slightly submerged leaves, or slightly submerged floatage, which have enough water over them to support a wiggle tail, a mere film being sufficient, but not enough to permit a minnow to swim above them, are the chief protectors of immature mosquitoes against fish. The small aquatic grasses, particularly *Hydrochloa carolinensis*, are a source of considerable difficulty in securing complete mosquito control with fish.[12] Also the green scums, or algæ, when they form dense floating pads, very frequently furnish excellent refuge for the immature mosquito. Many other plants, some of them strictly aquatic, others of the shore variety, often cause imperfect control when they are partly or slightly submerged. Plants which normally are wholly submerged, such as *Chara*, *Naias*, certain species of *Myriophyllum*, and others, oftentimes reach the surface during seasons of drought and they then form hiding places for the immature mosquito against fish. Water lilies cause imperfect control when the broad leaves become partly submerged or when they at times hold water in the center, while the margin remains above the surface of the surrounding water. Marginal vegetation is of importance in relation to mosquito control only when having partly or slightly submerged leaves. Many of these plants interfere with mosquito control only after freshets, when the level of the adjacent water is raised, submerging them partly, and again when they mature and the seeds or the plants themselves fall into the water.

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[12] Carter, LePrince, and Griffiths, Public Health Bulletin, U. S. Public Health Service, No. 79, 1916, pp. 28 and 29.

Hildebrand, Samuel F., Public Health Reports, U. S. Public Health Service, vol. 34, No. 21, 1919, p. 1121, or Report U. S. Commissioner of Fisheries, Appendix IX, 1919, p. 10.

Certain plants, such as the floating primrose willows and the tall wire grasses, frequently develop a mass of roots near the surface of the water which fish can not penetrate, and therefore provide a limited degree of protection for the immature mosquito. It has also been reported[13] that sunken leaves of trees, covering the sloping shores of a body of water, may gradually appear above the surface of the water as a lower water level ensues upon decreased rainfall and that they then cause serious trouble in maintaining mosquito control by the use of top minnows.

The tall plants with straight stalks and few leaves at or near the surface of the water, such as the rushes, cat-tails, etc., provide little or no protection for mosquito larvæ. Some of the smaller plants, as, for example, the duck weeds and certain water ferns, are not known to hinder mosquito control; they do not have dense root systems; their leaves float wholly upon the surface of the water; and therefore they furnish no refuge from fish for the immature mosquito. Observations indicate that these plants, when covering practically the entire surface of a body of water, may even prevent mosquito breeding. It is probable that the adult mosquito does not lay eggs among these plants, as frequently but little open water is present, and there is also a possibility that the eggs would be drowned by the more or less constant shifting of the weed masses as driven by winds or currents. The smartweeds, too, where they form a dense growth, appear to prevent mosquito production and it is probable that these weeds, because of their acrid nature, are offensive to the mosquito.

Since there are many conditions under which plants furnish protection for immature mosquitoes against fish, it is very essential in the conduct of antimalaria campaigns to make frequent and careful inspections of all waters. If it is found that certain plants are preventing complete mosquito control, then it is time to aid the minnows. The indiscriminate cutting and clearing of vegetation from water deposits is certainly not an economical practice, as such work is frequently unnecessary. The biological condition existing in each body of water must determine whether or not top minnows will require assistance from man to secure control of mosquito production. The kinds and the density of vegetation growing in each water deposit, the abundance of top minnows, and the amount of food available for the fish must be carefully considered.

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[13] This report was made by Associate Sanitary Engineer A. W. Fuchs of the U. S. Public Health Service.

A certain small pond at Augusta, Ga., stocked with *Gambusia affinis* in extreme abundance, was inspected in August, 1920. The water along shore supported innumerable small organisms, just visible with the unaided eye, which undoubtedly form a very important part of the food of minnows, at least of the young fish. Large *Anopheles* larvæ were not uncommon in the aquatic grass which grew in the shallower parts of the water. Another pond only a few hundred yards away, supporting a denser growth of grass and possibly fewer minnows, but lacking the small organisms in corresponding abundance, was under almost complete control. A little later during August, 1920, certain ponds at Thomasville, Ga., and Perry, Fla., were inspected and the conditions with respect to dense growths of aquatic grass were found to be very severe, yet in each instance perfect mosquito control appeared to obtain. Later, almost perfect mosquito control was found in sluggish ditches at Savannah, Ga., under conditions equally as difficult.[14] Top minnows in each instance were very abundant and food for the fish appeared to be scarce.

These observations show that minnows can and do sometimes furnish complete mosquito control under conditions which, superficially at least, are more adverse than others where such control does not obtain, and they led to the belief that if top minnows are abundant enough to create a real dearth of food, causing them to maintain a vigilant search for prey, mosquito control will then result even where extremely adverse conditions with respect to plant growths and floatage prevail.

An experiment was made at Savannah, Ga., during October, 1920, which gave at least limited proof of the supposition just stated. An isolated ditch, about 75 yards long and 3 to 4 yards wide, with growths of the aquatic grass (*Hydrochloa carolinensis*), creeping primrose willow (*Jussiæa diffusa*), pickerel weed (*Pondederia cordata*), the broad leafed arrowhead (*Sagittaria latifolia*), and a considerable amount of filamentous alga, was found to support comparatively few top minnows and quite a few mosquito larvæ. On October 19 and 20, approximately 7,000 top minnows, consisting of *Gambusia* and *Heternadria* and a few *Mollienesia*, were introduced from another source. On October 30 every part of the ditch was thoroughly searched and only a single large mosquito larva was found. Mosquito breeding had not ceased in the meantime, as certain polluted ditches near at hand, supporting no fish, continued to produce mosquitoes prolifically. It is evident, therefore, that the almost complete control which resulted within 10 days after introducing the additional minnows was brought about by the fish.

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[14] *Gambusia affinis* alone of the top minnows was present at Augusta and Thomasville, Ga., but at Perry, Fla., and Savannah, Ga., *Heterandria formosa* and *Mollienesia latipinna* were also present.

Conditions undoubtedly prevail under which it would be difficult to materially increase the number of top minnows already present. If the minnows have been established in a body of water for a long time, they probably have reached the limit of reproduction which is permitted by the existing biological conditions. Yet it is sometimes feasible for the purpose of mosquito control to disturb such conditions and thereby secure an increase of minnows. The enemies of the minnows, for example, may be removed from a body of water, places of refuge may be constructed for the minnows, or food may be added to ponds used for propagating them.

Frequently perfect mosquito control prevails in the shallower parts of ponds even though much vegetation is present, while the control is much less efficient along the shore edges of the deeper parts supporting less vegetation. Top minnows show a natural preference for shallow water, which may have been acquired because of the disaster wrought by the larger fish when the minnows enter deep water. The result is that the minnows are more abundant in the shallower sections of a body of water than they are in the deeper ones, and consequently better mosquito control prevails in the shallower parts than in the deeper ones, if the latter are suited to mosquito production.

MALARIA CONTROL WITH GAMBUSIA AFFINIS AS THE SOLE AGENT.

An experiment which was calculated to show the measure of mosquito control that may be attained by the use of top minnows, assisted by the clearing of vegetation where necessary, was conducted at Athens, Tex., during the season of 1920. The area used for the experiment was comparatively free of temporary water deposits and seepage, the potential mosquito-breeding places consisting mainly of 19 artificial ponds. *Gambusia affinis* was abundant in a few ponds in the locality which were accessible to it through natural channels. The supply of minnows for stocking the other ponds was obtained from these sources and from a sluggish stream a short distance from the city.

The following statements are quoted from a report by the sanitary engineer who had charge of the work:

"* * * A total of 14,720 *Gambusia* were placed in the 19 ponds mentioned. Their multiplication was rapid, and few *Anopheles* were found breeding up to the month of June, when heavy vegetable growth was completely removed. Four of these ponds were entirely free from this growth, due to their peculiar white clay banks. Dry weather, which followed, served to reduce the volume of water in the ponds, and the edges were entirely free from vegetation. *Anopheles* breeding was under control. Inquiry and observation proved that the mosquito nuisance had been greatly reduced.

"The effect of this work is best demonstrated by the following extract taken from a written statement made by Dr. J. K. Webster, city health officer, on September 1, 1920:

"'It is my observation that although there is more malaria in Athens this season than in previous years, there has been but very little in the area of mosquito-control work. In fact, in my own practice I have had no call to a case of malaria within the area of the work done.'"[15]

FISH CONTROL COMPARED WITH OTHER METHODS OF CONTROL.

Top minnows are of great value in controlling mosquito production in all permanent standing bodies of water, if in fact they are not the only agent known to date which successfully controls mosquito breeding in ponds and lakes. It has been demonstrated that top minnows are also very useful in sluggish ditches and streams, for at Savannah, Ga., all the ditches of the abandoned rice fields which supported top minnows, even though in many instances quite extensively overgrown with vegetation, were under almost perfect control during the latter part of the mosquito-breeding season of 1920, when the writer made inspections at frequent intervals. Identical results were observed under similar conditions earlier in the season of 1920 at Gulfport and Biloxi, Miss.; Wilmington, N. C.; and many other places. Minnows also are used in borrow pits, pools, potholes, cisterns, and shallow wells. Frequently it is feasible to use fish more economically than oil in temporary pools and ditches, depending upon how near at hand a supply of minnows is available and upon the length of time such temporary waters will remain. Probably it is seldom practicable to use fish when the waters dry up in less than a month, yet occasionally stocking a pool with fish is less expensive than one application of oil. Under such conditions it is an advantage to stock with fish pools remaining even a shorter period than one month. The situation with respect to the available supply of minnows and the cost of applying oil must determine in each instance which method is the more practicable. It is sometimes an advantage to dig a pit in the deepest part of a temporary pool or swamp which may hold enough water to carry at least some of the minnows through a period of drought.

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[15] These remarks are from a paper read by Mr. George Parker, sanitary engineer with the International Health Board, before the conference of sanitary engineers held at Louisville, Ky., on Nov. 16 and 17, 1920.

Top minnows may be used under at least the following conditions where oil can not be used to advantage: (*a*) In ponds and lakes where a continuous film of oil cannot be maintained because of wind action, (*b*) in waters used for drinking purposes, whether for man or beast, where oil is objectionable, and (*c*) in places where certain types of vegetation which break the oil film are present, but which very frequently do not hinder mosquito control by fish. As already shown, conditions produced by plant growths exist under which absolute control with fish may fail, but under such conditions practically the same process of cutting and removing vegetation is necessary to secure control either with oil or with fish. Fish control, being of a much more enduring character than oiling, is therefore, preferable. It is well known that in order to secure mosquito control oil must be applied throughout the summer at intervals of from 7 to 10 days and during rainy weather oftener. The writer has not seen a permanent body of water where if the fish were once established they did not remain, unless killed or driven away by pollution. The many ponds at Augusta, Ga., which either were already stocked naturally or which were stocked artificially in 1918, were nearly all under perfect control in August, 1920, the fish in many ponds having multiplied greatly, while in others the biological limit of production had probably been reached in 1918.

The relative cost of mosquito control with fish as compared with control by the use of oil for a single season has not been well established, as no data based on somewhat similar situations have been collected. However, it is evident that if top minnows are available in a given locality (and they are abundant almost everywhere in the malarious sections of the South), the cost of fish control consists merely in distributing the fish, and in some instances the fish must be assisted by removing vegetation and floatage which furnish protection for the immature mosquito against fish. When oil is used, the cost of the product at present prices is a large item and the cost of distributing and spraying the oil at frequent intervals undoubtedly is greater than stocking with fish the waters within the same area, under the average conditions obtaining in the malarious sections of the South. The removal of vegetation and floatage is sometimes necessary whether oil or fish are used, and the cost of that work does not need consideration here, as it probably would not materially alter the final comparative cost of the two methods of control. It, therefore, is quite evident that as far as fish can be used, certainly the cost of the oil is saved by employing fish, with the further advantage that mosquito control thereby obtained is usually not limited to the first season but may continue indefinitely.

Of course conditions exist where oil can be used to advantage and where fish are worthless. Fish can not be employed where a mere film of seepage exists or in hoof prints, and it frequently is not advantageous to use fish in very temporary pools, ditches, and swamps. Top minnows often do not work well in swiftly flowing creeks which, however, have quiet coves and pools. It seems advisable, therefore, because of the small cost and the more permanent results, to use fish under all conditions under which they will provide mosquito control and to apply the oil treatment only when fish can not be successfully used.

Drainage undoubtedly deserves first place among the measures of mosquito control because of its permanent character, but it is a recognized fact that all water deposits can not be eliminated. The cost of drainage is usually high and therefore in many localities prohibitive. It is not always possible to replace control by drainage with control by fish, as when the breeding areas consist of waters which will not support fish, but it is quite feasible to employ fish in all permanent standing waters which are not polluted or overpopulated with large predaceous fishes. Fish control is especially recommended for rural sections and for other localities when funds for the more expensive measures are not available. Certainly a great reduction in malaria can be obtained by the judicious distribution and protection of top minnows.

CONCLUSIONS.

1. *Gambusia affinis* is by far the most important natural enemy of the mosquito known to date. Throughout the malarious sections of the South it is abundant in nearly all permanent standing bodies of water and sluggish streams accessible to it. The use of *Gambusia affinis* in several southern States during antimalaria campaigns in 1920 resulted in a reduction in the cost of mosquito control and added much to the permanent nature of the work.

(*a*) This fish lives under a very wide range of conditions, and especially frequents the places which appear most favorable for the production of mosquitoes. There are some waters, mostly artificial, which are inaccessible to it, because of the presence of barriers, but if the fish are transplanted thereto a large reduction in mosquito production will result.

(*b*) *Gambusia affinis* seeks its food at the surface of the water and shows a distinct preference for live animals, but it also eats dead animal food and plants. Its sense of smell appears to be imperfectly

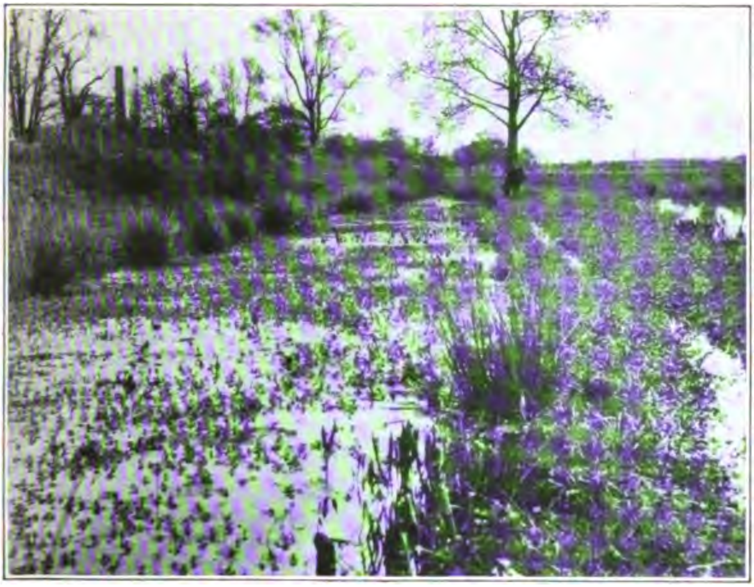

Fig. 21.—Section of ditch in abandoned rice field, Savannah, Ga., showing arrowheads, pickerel weeds, and primrose willows in water. Photographed April 14.

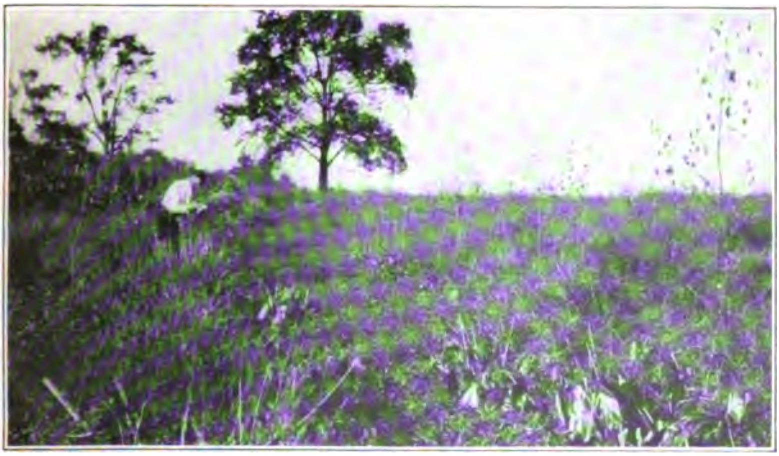

Fig. 22.—Same view as in above photograph. Note that ditch is now completely overgrown with vegetation. Top minnows were plentiful and excellent mosquito control prevailed. Photographed October 22.

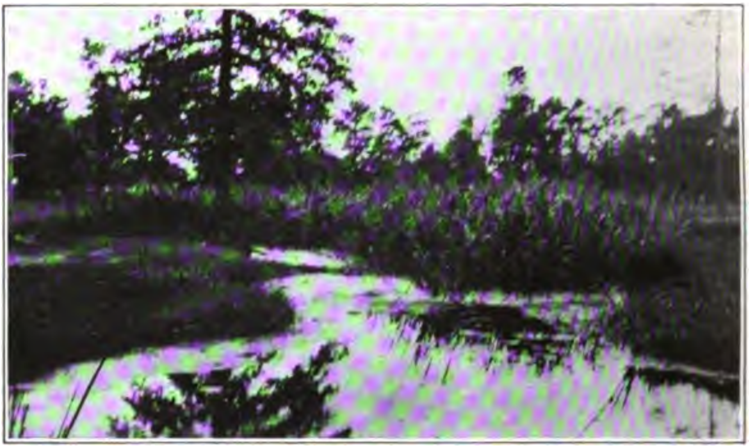

Fig. 23.—Section of pond, Trinity, Tex., showing growth of rushes which do not prevent mosquito control with fish. This pond was used as a "hatchery." Photographed June 3.

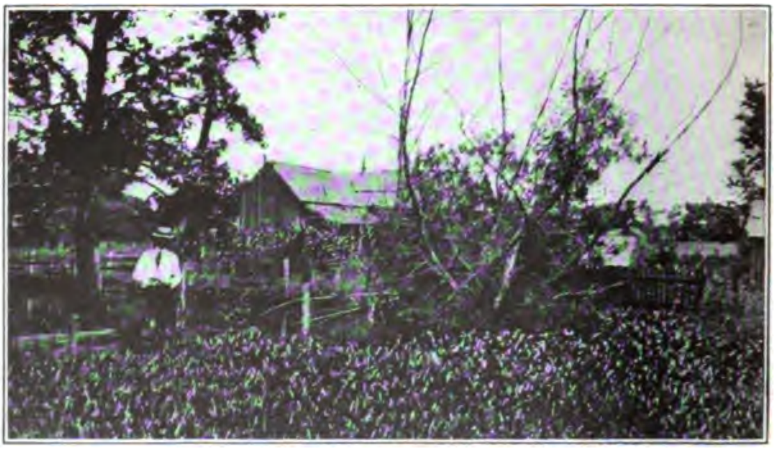

Fig. 24.—Shallow section of pond, Huntsville, Tex., showing area in foreground completely overgrown with burweed. Gambusia affinis was abundant and complete mosquito control prevailed at the time when the inspection and photograph were made, June 4.

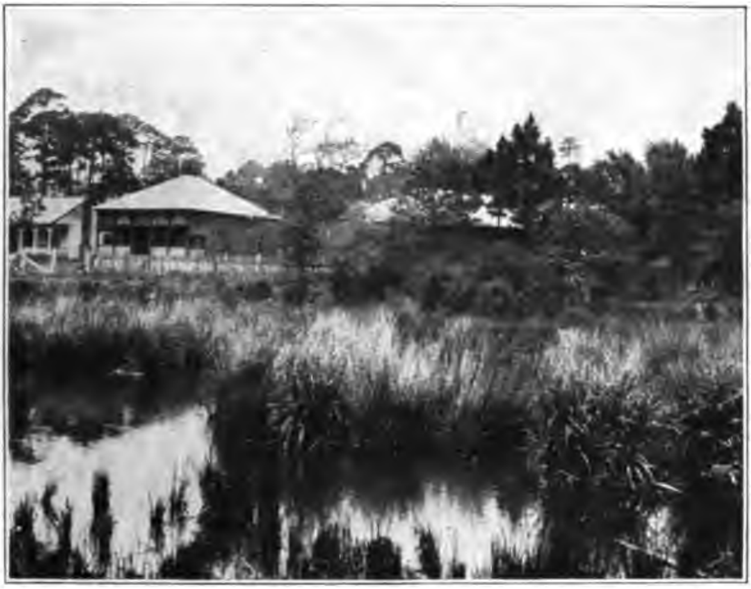

Fig. 25.—Slightly brackish swamp, Gulfport, Miss. Type of tall vegetation which rarely hinders mosquito control by fish. Minnows very abundant. Photographed April 27.

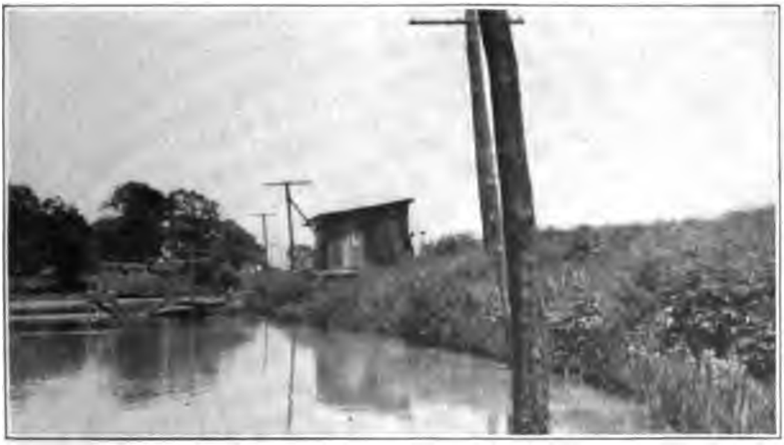

Fig. 26.—Section of pond at Jacksonville, Tex., showing shore vegetation. Fundulus notatus failed to provide mosquito control, and Gambusia affinis was added to secure complete control. Photographed June 1.

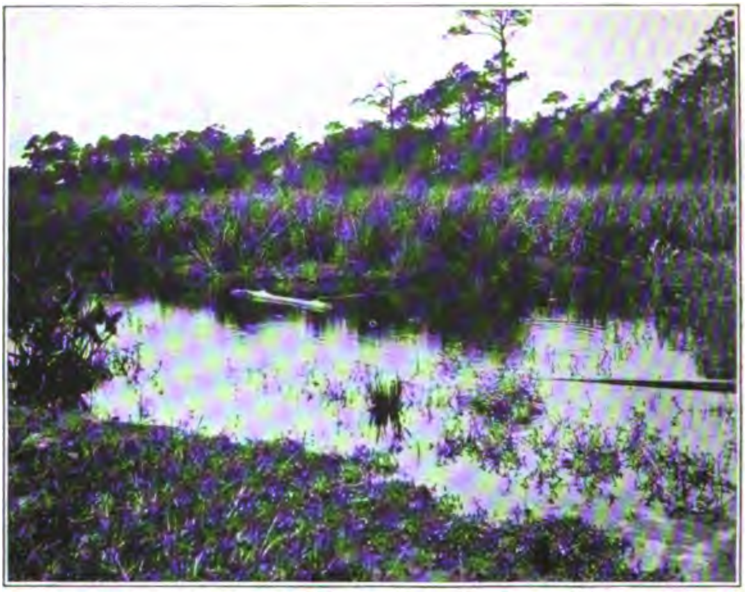

Fig. 27.—Section of a swamp, Gulfport, Miss., showing types of vegetation which usually do not protect mosquitoes from fish. Photographed April 27.

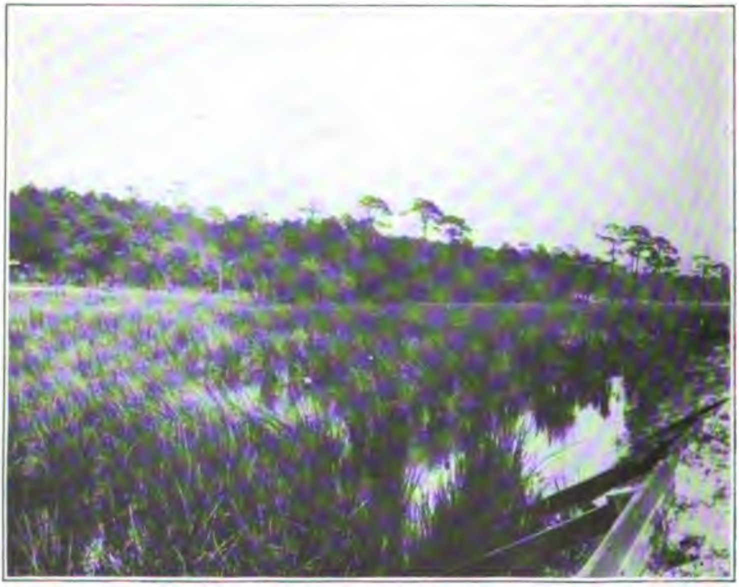

Fig. 28.—Section of same swamp as above, showing close view of tall wire grass. Rarely mosquito larvae find protection from fish among the root masses of the clumps of grass. Photographed April 27.

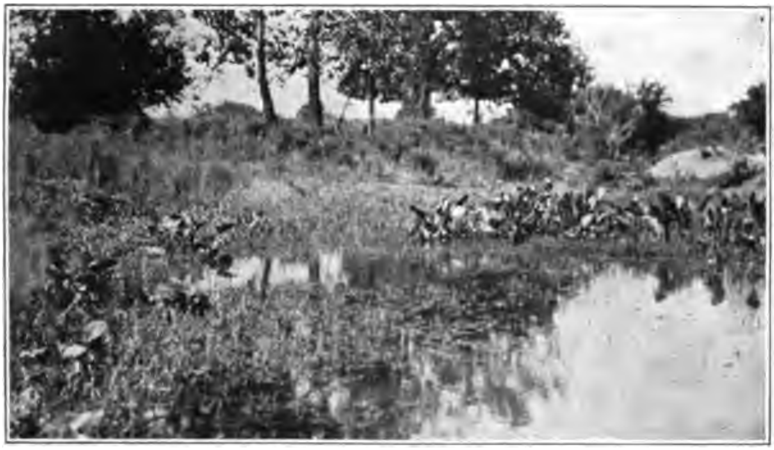

Fig. 29.—One of a chain of sink holes, Perry, Fla. Top minnows were abundant in most of them and many of them were under almost perfect mosquito control when inspected and photographed, August 11.

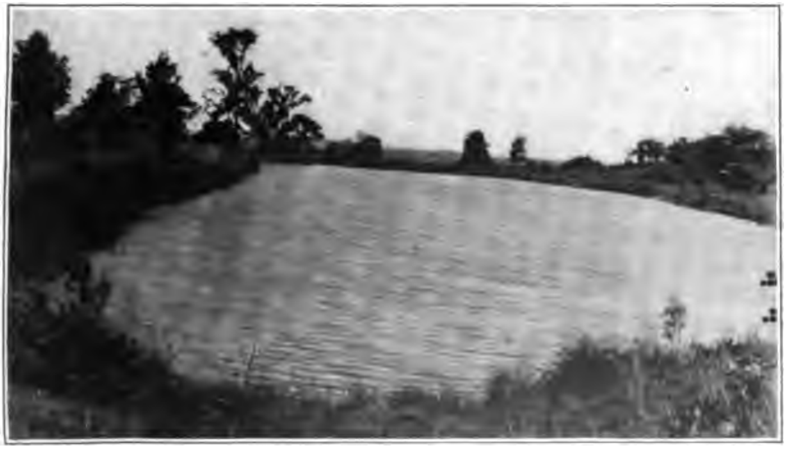

Fig. 30.—A type of pond which, because of size, depth, and freedom from vegetation, is subject to considerable wave action. Mosquitoes are able to breed only along the shores where they usually are easily controlled with fish.

TREASURY DEPARTMEN
UNITED STATES PUBLIC HEALT

PUBLIC HEALTH BUL

JANUARY, 1921

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OF

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IN MALARIAL FIEL [illegible]
AND MOSQUIT [illegible]

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 115
JANUARY, 1921

TRANSACTIONS
OF
THE SECOND ANNUAL ANTIMALARIA CONFERENCE
OF
SANITARY ENGINEERS AND OTHERS ENGAGED IN MALARIA FIELD INVESTIGATIONS AND MOSQUITO CONTROL

HELD AT LOUISVILLE, KY.
NOVEMBER 16-17, 1920

Prepared by Direction of
THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1921

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 115
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malaria problem must appeal to any thoughtful person as one of the chief questions in any community where it is prevalent. Health must be considered as one of the main aspects of any place.

It is important simply from the standpoint of health. Physical preparedness underlies all other preparedness. Malaria is a subtle disease. It constantly lowers the efficiency of the patient, it decreases the resisting power of the system to throw off other diseases, it enters frequently into complications with other diseases, and, at times, makes diagnosis uncertain.

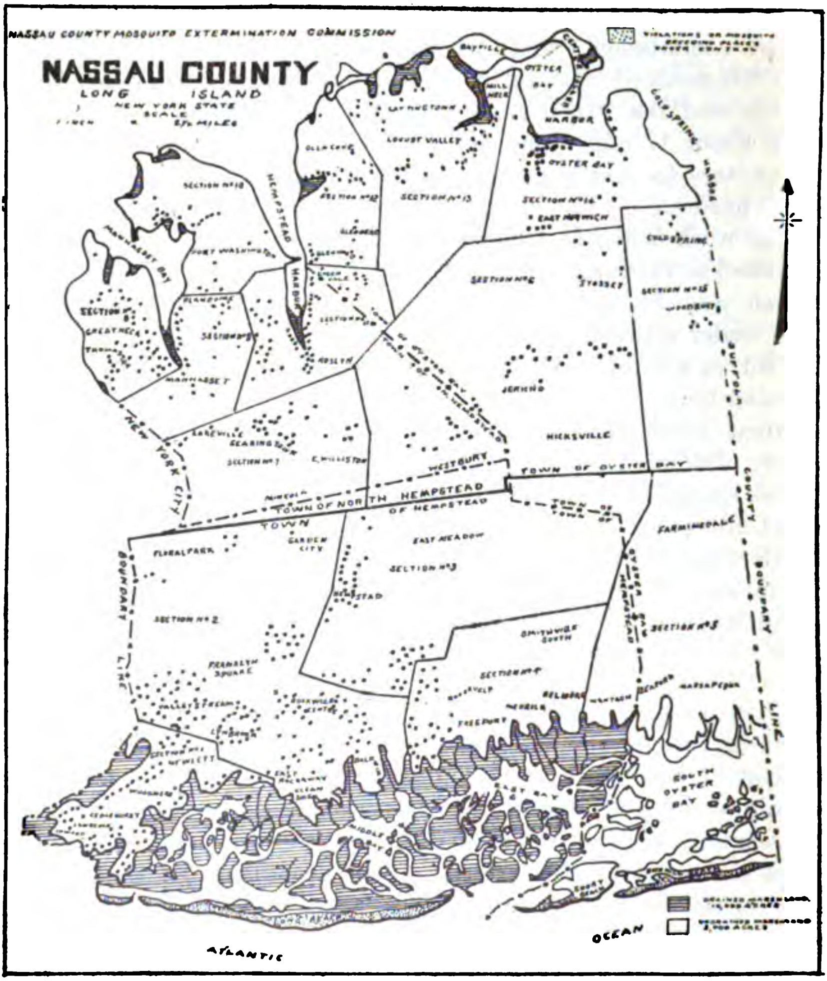


FIG. 1.

Malaria can be prevented. How? By exterminating the Anopheles mosquitoes, and keeping their breeding places under control; by organizing a system that will enable the men in charge of the inspection and oiling to get over the territory often. The chief engineer must be in constant touch with his men, cooperating with his force at all times, and with but one object in view—mosquito extermination and malaria control.

HISTORY OF MALARIA CAMPAIGN.

Shortly after scientists proved the Anopheles mosquito to be the only transmitter of malaria to man, mosquito extermination on the north shore of Nassau County was agitated.

In 1910 the Matinecock Neighborhood Association of Locust Valley carried on a $6,000 campaign, and for the next four years maintained the work installed. Following the pioneer work of this association, the people of Port Washington and Glen Cove expended some $2,000 in 1914 on oiling, ditching, and maintenance. The work was continued in 1915 by the Great Neck Association, which did approximately $1,000 worth of work.

So the fight against malaria was carried on in the county for several years by individuals, societies, welfare organizations, and communities until in 1916 the Nassau County Mosquito Extermination Commission became operative, and took over the work of the local organizations.

MALARIA CONDITIONS.

It might be well to look briefly at the record of the upland work done by the commission in the past four years, so that some idea may be gleaned of the effort put forth to obtain the results mentioned hereafter.

As the commission was not organized until June, 1916, the malaria work that year consisted chiefly of maintenance of the work previously installed and location of breeding places.

In 1917 the commission maintained an upland labor crew, consisting of 1 foreman, 18 laborers, and 10 inspectors, on the north shore. The district included the territory from Great Neck east to Cold Spring Harbor on the north and from Floral Park east to Mineola, thence along the old country road to Plainview on the south, covering an area of approximately 135 square miles. This section of the county was being inspected and patrolled by 10 inspectors, whose only means of transportation were bicycles. The oil was transported by horse and wagon, and sprinkling cans were used for pouring the oil on the surface of the water of the numerous violations or breeding places.

This was a slow and expensive method, accomplishing very little, and necessitating years of hard work to obtain the results that we have obtained in three years under the present system.

It was not until 1918 that the organization of the upland work was satisfactorily established. In 1918 I was appointed chief engineer. Having been in the employ of the commission as a district inspector since it was organized, I was in a position to see that in order to exterminate the Anopheles mosquitoes and get malaria under control a new system of inspecting and oiling must be installed. The only solution, where the territory was so large, was the installation of automobiles.

AUTOMOBILE TRANSPORTATION.

I brought the question of transportation before the commissioners, recommending the use of automobiles for inspecting and oiling of upland violations on the north and south shores. This was approved by the commission, and four automobiles were purchased at once. The cars were equipped with a small box body, large enough to carry one barrel of oil, two spray pumps, and two 4-gallon oil tanks.

Instead of employing a man to do inspection and another to do oiling, I combined the work and had the inspector do the oiling, too.

I am very much in favor of teamwork; two inspectors work together better than one man alone. This is the method: One automobile, two men, one barrel of oil, two small oil tanks with pumps, hose, and spraying nozzle attached. Inspections are made and when breeding is found the breeding place is oiled and the larvæ killed immediately. Our motto is, "Kill it while it is young."

COMPARISON OF OLD AND NEW SYSTEMS.

Season of 1917, transportation—bicycles, horse and wagon.

Number of inspectors employed	10
Total number of inspections made	1,329
Total number of violations	206
Total number of times breeding killed	330
Total number of gallons of oil used	2,600
Number of malaria cases reported in four communities	51
Cost per acre (on north shore) (cents)	14

Inspections made every 12 days.

Season of 1918, transportation—automobiles.

Number of inspectors employed	5
Total number of inspections made	5,788
Total number of violations	355
Total number of times breeding killed	595
Total number of gallons of oil used	3,308
Number of malaria cases reported in 4 communities	0
Number of malaria cases reported in entire county	5
Cost per acre (on north shore) (cents)	8

Inspections made every 8 days.

CHECKING CHART SYSTEM.

In order to keep a complete record of the inspections made, breeding found and exterminated in the upland violations, a checking chart was installed. The north and south shore upland was divided into two districts, and the districts were divided into sections. In each section there are from 12 to 135 ponds, swamps, pools, streams, and wet areas, which we call violations or breeding places. In the county there are 15 sections, 5 on the south shore and 10 on the north shore.

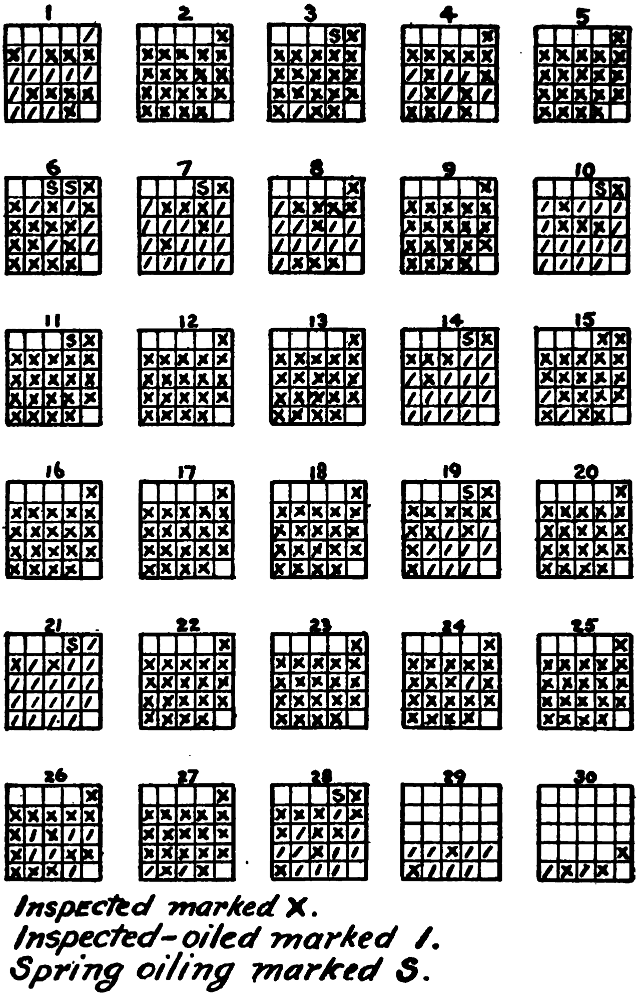


FIG. 2.—Nassau County Mosquito Extermination Commission. Sample chart showing violations inspected or inspected-oiled. North shore, season 1920, section No. 10, Port Washington.

CONSTRUCTION OF INSPECTION CHART.

The large squares on the chart indicate the violation, and the small squares show the number of times the violation was inspected. The squares marked with a black cross show inspections but no breeding found. Squares marked with a diagonal line show inspections, breeding found, the violation oiled, and the larvæ killed. We have a full set of these charts covering the seasons' work on the north shore from 1917 to 1920.

PERSONNEL.

During the year 1918 two upland labor crews, consisting of 2 foremen and 10 laborers, were employed to do the maintenance work on the north and south shores. In 1919 the same number of inspectors and laborers was employed on the upland districts. The malaria was kept well under control; only three cases were reported in the entire county.

The Anopheles mosquitoes have been fought to a standstill. Although they were found breeding in 24 communities, the commission made a record this year. The field force worked with untiring efforts to keep malaria out of the county.

Summary of upland work, season of 1920.

Total number of violations	652
Total number of inspections	12,595
Total number of times breeding killed	1,877
Total number of gallons of oil used	16,443
Total footage new ditches installed	28,864
Total footage old ditches cleaned	663,449
Total footage old ditches recleaned	12,425
Total number ponds lowered	34
Total number swamps drained	1
Total footage pond edges trimmed and cleaned	5,000
Territory under control (square miles)	200
Cost per acre (with high cost of labor) (cents)	12
Number of cases of malaria in entire county	0

Inspection made every 6 days.

District No. 3, breeding summary, season 1920.

Violation.	Total number times breeding.	Culex.		Anopheles.		Aedes.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Ponds	974	316	32.4	595	61.2	63	6.4
Swamps	355	231	65.0	26	7.5	98	27.5
Ditches	143	91	63.8	31	21.8	21	14.4
Salt marsh	1	......	......	......	......	1	100.0
Gutters	14	9	64.2	5	35.8	......	......
Streams	29	11	37.8	17	58.4	1	3.8
Pools	178	142	79.5	14	8.0	22	12.5
Catch basins	3	3	100.0	......	......	......	......
Cisterns	2	2	100.0	......	......	......	......
Lily basins	48	16	33.1	29	60.5	3	6.4
Cesspools	15	15	100.0	......	......	......	......
Barrels	11	8	72.7	......	......	3	27.3
Culverts	7	5	70.0	2	30.0	......	......
Springs	......	......	......	......	......	......	......
Wet areas	42	30	71.5	5	12.0	7	16.5
Total	1,822	879	48.2	724	39.8	219	12.0

COST OF OPERATIONS.

Following is the cost of operations from April to September 30:

Chief engineer, secretary, and clerk	$2, 526. 00
2 district inspectors	1, 663. 00
11 inspectors	7, 287. 50
2 foremen	1, 200. 00
24 laborers, salt marsh and upland	11, 834. 00
Total	24, 510. 50

Motor transportation.

Repair parts, 8 cars, 3 boats, 1 motor cycle	375. 57
Gasoline, 8 cars, 3 boats, 1 motor cycle	1, 181. 34
Lubricating oil, 8 cars, 3 boats, 1 motor cycle	64. 50
1 machinist	685. 00
Total	2, 306. 41
Cost per vehicle per month	32. 04
Cost per vehicle per working-day	1. 24

DOCTORS' MALARIA REPORTS.

In 1916 we sent reports to the physicians in four north-shore communities, requesting them to report to us any cases of malaria which had occurred. In 1917 we sent reports to all north-shore communities, and in 1918, 1919, and 1920 to all physicians throughout the entire county. Their response has been general and gratifying, and their cooperation is highly appreciated.

The following table gives a comparative summary of malaria conditions throughout the county:

	Annually to 1916.	1916	1917	1918	1919	1920
Number of communities reporting	4	4	7	19	18	15
Number of doctors receiving reports		16	41	111	99	82
Number of doctors reporting		14	23	35	46	28
Number of reports received		82	133	79	289	254
Number of cases:						
North shore	475	56	51	5	2	0
South shore					1	0
Total for county	475	56	51	5	3	0

It is convincing proof of the success of the work that in 1920 reports from all localities in the county reveal no cases of malaria as compared with 475 annually from only four communities previous to 1916. The number of cases reported in the last three years—5 in 1918, 3 in 1919, and none in 1920—shows that the work carried on by the commission has effected an absolute control of malaria conditions which a few years ago were alarming.

One big factor of our success is our motor transportation. It might be well to state at this time that we have a fully equipped repair shop, and one expert machinist who keeps the cars and boats in perfect running order. The commission has purchased more cars, and now owns 8 cars, 3 boats, and 1 motor cycle. Unquestionably, motor transportation has given Nassau County mosquito extermination.

DISCUSSION.

Mr. LE PRINCE. We have all enjoyed your paper very much, Mr. De Mott. I hope enough questions will be asked so that we will get the full value out of this paper. The subject is now open for discussion. I will set the ball rolling. I want to ask Mr. De Mott whether or not there was any difficulty in convincing the commissioners of the need of transportation, and also ask what arrangements were made regarding funds for each year. Do you have any difficulty in obtaining the funds, or is that arranged for? Does it take up any of your time?

Mr. DE MOTT. In regard to the automobiles that were procured for transportation, the commissioners opposed them very strongly until I showed them that in order to get results we must get over the territory quickly. We have covered 17 miles of the north shore and the same on the south shore. It was impossible for the men to get over that territory on wheels. After explaining it, the commissioners readily understood that we must travel fast if we were to have results.

With reference to the money in Nassau County, we are allowed three-eighths of a mill to the dollar of assessed valuation. In other words, on $1,000 of assessed valuation we receive 37½ cents for mosquito extermination. During the year of 1916 we received $40,000; 1917, $40,000; 1918, $48,000; 1919, $54,000; 1920, $54,000. Next year our appropriation will be more, because the assessed valuation of the county has increased. It will be approximately $74,000. We have a population of 130,000.

Mr. LE PRINCE. I want to ask how you brought that state of affairs about; in a few words, the inside history of the getting that law passed, if it is a law?

Mr. DE MOTT. Previous to the organization of the commission, this work was carried on by private organizations. In order to get results, it must become a county-wide proposition. All that was necessary to get this bill through the legislature was a petition signed by 200 taxpayers of the county. The work on the north shore, which is the richest section of Nassau County, was being handled by a number of influential men who were ready and willing to sign this petition. As soon as the petition had been properly signed, it was presented to the assemblyman of Nassau County, who presented the bill to the legislature.

Dr. FRICKS. I have no question to ask Mr. De Mott, but I certainly was delighted to hear his paper. I wish some of the doubting Thomases that we have all encountered with respect to drainage on a county-wide basis could have heard Mr. De Mott's paper.

I have been of the opinion since my connection with the work that if we are going to carry it on permanently and extend it properly, malaria control here in the South must be on a county-wide basis. I believe the county is the logical health unit in the southern States, and that unless we put our malaria control on that basis we have no assurance of its permanency. I feel that it is up to you engineers to profit by the paper this morning and evolve some logical way of doing in the South what they have done in New York.

Mr. DE MOTT. I want to say for the benefit of the members, do not think for one minute that we don't have criticism. We do, from one end of the county to the other. The hay farmer criticizes us because we have ruined his hay meadow. This is not true. When you drain the salt marshes you increase the yield of hay 75 per cent, and the only thing he loses is the place where the sod lies on both sides of the ditch. They have criticized us for four years, and we have stood their criticism knowing that they did not know what they were talking about, and we know what we are doing. Regardless of the cost, regardless of the criticism, we know that we are doing a work for the benefit of mankind. Until we educate the people, we will never get complete results; but never mind, whether you educate them or not, fight the thing from start to finish, regardless of criticism. A lady said to me, "We are not bothered with mosquitoes, nor do we have malaria." She wanted to get an officer and have our men arrested because they walked on her property in order to oil a pond which was breeding malaria mosquitoes. If we had taken our men off that place, we would have accomplished nothing. Mosquitoes would have gotten on the wing, malaria would have been prevalent in that village as it had been once before. In 1916 there were 48 cases in that village; to-day, none, just because we know what we are doing and they don't know what they are talking about. [Applause.]

Mr. O'NEILL. I would like to ask Mr. De Mott the character of the population of Nassau County; that is, is it mainly rural or does it consist of small towns or one large town.

Mr. DE MOTT. We have 19 incorporated villages, and in those incorporated villages there are from five to nearly ten thousand people.

The rest are small towns, rural districts. With one or two exceptions the villages do not have sewerage. They have cesspools which are our main trouble. The people think because the cesspool cover

words, is the town worked in conjunction with the rest of the county without doing anything in the way of raising money for local work?

Mr. De Mott. The money that is raised for mosquito extermination for Nassau County is for Nassau County, from the north shore to the south shore, from the Sound to the ocean. We are fighting malaria for humanity; it doesn't make any difference whether it is a negro or who it may be.

Mr. Hoskins. Has fish control been attempted in ponds, especially on those estates where the beauty of the pond is an asset to the property?

Mr. De Mott. Fish control was attempted in several of the ponds. We find that the fish will not eat all of the wrigglers, and a great many of the pupæ are left, and get on the wing.

Mr. Le Prince. I would like to ask a question. Did you find that the public was anticipating the visits of the inspectors and actually cooperating by doing the work that you would otherwise have to do?

Mr. De Mott. Yes. We make it a special work of the inspectors to get in touch with the owners, or the superintendent on the property. We generally talk with the superintendent in charge, who cooperates with us. Sometimes they do the work themselves; sometimes they go with us and see how we do it. On the north shore, where we have our malaria problem, we have found that the superintendents on the different estates have been willing to cooperate with us in every respect.

Mr. Old. I would like to ask, Mr. DeMott, what kind of oil you use?

Mr. De Mott. We use No. 34 distillate fuel oil.

Mr. Old. Does that spread among the vines that you speak of in the water?

Mr. De Mott. Yes. We tried kerosene, and found that it would kill the Anopheles but would not kill the Aedes. One of our inspectors said to me, "I think the Aedes larvæ are getting fat on kerosene." We took the dripping of oil from the cars and mixed it with kerosene and that has a kick. I wish I could get that kind of oil all of the time.

Breeding of Anopheles was higher this year on the north shore than it has been for two years. Thirty-nine and eight-tenths per cent of the breeding found was Anopheles. In some districts the Anophe- were as high as 100 per cent. Most of them were *quadrimaculatus;* had very few *punctipennis.*

Dr. Griffitts. Mr. De Mott, is *quadrimaculatus* found in brackish ater?

Mr. De Mott. No; not in brackish water; mostly in brooks and ponds.

Dr. Griffitts. You did encounter *crucians?*

Mr. De Mott. Yes; but very few.

Mr. Komp. What kind of spray pump was used?

Mr. De Mott. The spray pump is the Deming sprayer. It has a 4-gallon container and a foot pump. We used a 4-foot hose and a Bordeaux sprayer. The knapsack spray we received, but the men refused to use them, because the oil got on their clothes. I procured the Deming sprayers and they were very successful.

Mr. Komp. Do you know what species of fish were used?

Mr. De Mott. No; I don't know what species were used. I am not much interested in fish control, to tell you the truth.

Mr. Hildebrand. I wish to remark that Mr. De Mott is handicapped in fish control because he does not have the species of fish that we have in the South and probably that is the reason he has not had as much success as we have had in the South. I know from our northern representative, Dr. Moore, of Pennsylvania University, that fish control has not met with the success there that we have had in the South.

Mr. Van Hovenberg. Mr. Chairman, I would like to speak about something I saw in California this summer, in case the question of spray pumps is not brought up again this morning. We have all been troubled with the complaints of oilers, due to the spilling of oil from spray pumps upon their backs. The California spray pumps had a metal strip about an inch and a half wide soldered around the whole top of the can, so that any oil escaping from the valve may be caught on the inside of the rim. This will avoid absolutely the spilling of the oil down the carrier's back. .

Mr. Parker. Mr. De Mott said, I believe, that they were not paying very much attention to Culex. I would like to ask whether containers affect Anopheles production?

Mr. De Mott. We found that the Anopheles breed in the ponds, brooks, and streams. We have found Anopheles in barrels, that is all. We do not say that we are not killing the Culex. We have a great many stagnant ponds where Culex breed, but that does not include the house-to-house work.

Dr. Harrison. Mr. Chairman, I should like to ask Mr. De Mott just what connection the State board of health has with the work in New York, and how many counties are carrying on mosquito-control work in the State at the present time?

Mr. De Mott. Nassau is the only county in the State that is doing mosquito extermination outside of Greater New York. I believe that Suffolk County is going to put through a bill in the legislature this winter to have mosquito extermination instituted.

We work under the direction of the State board of health. My proposed annual budget is sent to the State board of health, and it has to be approved by Mr. Horton, the chief engineer. He can approve or disapprove of the amount of money that has been raised, but has been very courteous. The State board of health does not assist in obtaining appropriations.

Dr. **Harrison**. Just one other question. You stated your appropriation for the past two years was fifty-four thousand. Now, do you think that there is a material decrease in the upkeep of your work, and what are your plans for continuing? Is it going to cost that much indefinitely?

Mr. **De Mott**. No. The largest amount of our appropriation each year has been used in the installation of ditching on the salt marshes. We have spent each year approximately fifteen to sixteen thousand dollars for drainage work on marsh land alone. We have about 2,000,000 linear feet more to install and then these salt marsh areas will be drained. After the drainage is completed it will cost at least $14,000 a year to maintain it, but the cost of installation will cease, and the amount of appropriation will be less, because we use a smaller amount of money on the upland than we do on the salt marsh. I should judge we will be able to maintain the work in Nassau County, probably in 1923 or 1924, for $34,000 a year. I don't feel like stating any less amount than that for the work.

Mr. **Shaw**. Have you experienced any difficulty or objection on the part of the people because of funds being used more in one locality than in another?

Mr. **De Mott**. We wanted the people of Glen Cove City to blast a pond. Immediately they wanted to know if the money raised through taxation did not pay for mosquito extermination in Glen Cove City, and if they received their pro rata share of the work. I said, "Gentlemen, we are doing mosquito extermination in Nassau County wherever it is. If you have 50 violations we will take care of them; if you have only 1 violation we will take care of that. You are getting your pro rata share. We are taking care of the pond by oiling; if it was blasted it would be entirely eliminated."

Mr. **Davis**. I want to get straightened out on the Culex proposition. You say you do not bother with the house-to-house work, the containers breeding Culex?

Mr. **De Mott**. No. We will not get rid of the Culex until we take up the house-to-house work. We are fighting the salt-marsh and upland fresh-water mosquitoes. Don't think, gentlemen, that we don't have mosquitoes in Nassau County. We do, but most of them are *Culex pipiens*.

Mr. **Le Prince**. Anybody here who is interested—and you should all be interested—in the New Jersey work ought to get a publication prepared by Dr. T. J. Headlee, State Entomologist of New Jersey, New Brunswick, N. J. It is well worth reading; everybody here ought to have it, particularly the State health department officials.

As we are pressed for time, there will be no further discussion of this paper, but for the benefit of those who were not here in the opening part I would like to state that there was as much valuable information given in that paper and in the early part of the discussion as there was real amusement in the latter part of the discussion, and everybody most certainly should read it. It brings to you what the State health departments are about to undertake, or will undertake within the next few years—the control of malaria in the rural districts; the big project. There is no reason at all why our Southern States can not undertake county-wide projects as has been done in the North, and the general manner of procedure has been laid down in Nassau County and in various counties, five of them, in the State of New Jersey.

I think we all owe thanks to the Nassau County Mosquito Extermination Commission for sending Mr. De Mott to give us the valuable data he has given us this morning. [Applause.]

(The conference gave the Nassau County Mosquito Extermination Commission a rising vote of thanks.)

Mr. **Le Prince**. The next paper this morning will be "Service policy and administrative methods in malaria-control investigations," by Dr. Fricks.

Dr. **Fricks**. I am pleased that the chairman has arranged for my paper to follow Mr. De Mott's. He has just told us how mosquito control is actually being conducted on an extensive scale in New York, and I believe his experience will enlighten us as to the probable lines along which malaria control in the South will be developed in the future.

SERVICE POLICY AND ADMINISTRATIVE METHODS IN MALARIA-CONTROL INVESTIGATIONS.

L. D. FRICKS,
Surgeon, United States Public Health Service.

"Not a day passes over the earth but men and women of no note do great deeds, speak great words, and suffer noble sorrows. Of these obscure heroes, philosophers, and martyrs, the greater part will never be known until that hour when many that were great shall be small and the small great." In this strain Charles Reade deplores the inadequacy of historical records. This stricture applies with great truth to at least one phase of malaria control. How much the early settlers of the United States and their descendants unconsciously contributed to the control of malaria through their desire for increased crops and better living conditions can never be known. How much the better class of rural families are now contributing to the same end for exactly the same reasons, without any thought of the mosquito theory of malaria transmission, can only be surmised. Unquestionably, however, their contribution is great. But except for a few sporadic efforts, the active measures taken for the control of malaria in the United States are of such recent date as to be commonly known to everyone interested in public health work. The first chapter in the control of this disease in the United States was written in great part by officials of the Public Health Service under the guidance of Dr. H. R. Carter, Dr. R. H. von Ezdorf, and Senior Sanitary Engineer J. A. Le Prince.

It covered the period between 1913 and 1918. In the beginning less than $3,000 was allotted for malaria investigations from funds appropriated for the field investigation of public health. These investigations consisted of (1) collection of information concerning malaria prevalence and distribution, (2) demonstrations of malaria control, and (3) educational campaigns. The popular demand for demonstrations in malaria control grew so rapidly that additional funds were required each year in order to partly meet the demand. However, the allotment for malaria investigations for any one year previous to 1918 did not exceed $20,000. By the end of 1917 it had been clearly demonstrated that malaria could be controlled, in urban communities, at least, through drainage and oiling; and that in communities where malaria was prevalent, the cost of such control was considerably less than the annual tax from malarial diseases. The first chapter in malaria control investigations in the United States was closed at the end of 1917—malaria control in certain localities had been clearly proven possible and generally profitable and therefore this aspect of malaria investigation may fairly be considered as successfully terminated.

The second chapter in the Public Health Service control of malaria was of an entirely different character—it had to do with the protection of the health of our soldiers under war conditions. It consisted of malaria control and not malaria-control investigations. An appropriation of $500,000 was made by Congress for "protecting health of the military forces." A sum greater than this amount was secured from local communities around the different cantonments, and these funds, amounting to more than $1,000,000, were spent in 27 extra-cantonment zones for the protection of the health of the soldiers and civilian populations. By far the greater part of this fund was spent around cantonments located in the South, and at these places the greatest expenditure was for malaria control. An emergency had to be met; time was precious, and necessarily under this pressure due economy could not always be practiced. However, those of us who had seen the deplorable insanitary conditions existing around southern military camps during the Spanish-American War and the resulting waste of human lives can but feel that the expenditures as made for the protection of the health of our soldiers in the World War were amply justified. This was a chapter dealing with malaria control alone, except in so far as general deductions may be made for future control work, and should not be taken as a standard of service activities and service cooperation for malaria-control investigations of the future.

The third chapter of service malaria-control investigations begins with the discontinuation of extra-cantonment activities by the Public Health Service in 1919. The same general policy in malaria investigations as had been conducted before the war was resumed, but upon a more extensive scale. An allotment of $80,000 was made from the appropriation "Field investigations of public health for the year 1919." Because of the influence which radiated from the extra-cantonment areas, it was deemed wise at this time to enter into a cooperative agreement with 10 different State health authorities and the International Health Board in a widespread investigation of malaria control in urban communities and the possibilities of its extension therefrom and incorporation as a part of the regular health program of State and local health authorities. This cooperative agreement was not completed until the season of 1919 was well advanced, but the personnel of the field force was selected and many preliminary malaria surveys were made before the end of the year.

These cooperative malaria-control investigations have now been in operation throughout one season, and we are here to discuss service policy and administrative methods in carrying on this work. In beginning this discussion it will probably be well to quote the memorandum prepared in the bureau outlining the reasons for and plan of conducting cooperative malaria investigations and control:

> In order to promote the control of malaria in the United States and to accelerate the conduct of this work by the properly constituted authorities, the following plan of cooperation between State and local health authorities, the International Health Board, and the Federal Government, through the Public Health Service is proposed:
>
> 1. The Public Health Service will, on the approval of the plan and the request of the State board of health officer, assign to States officers trained in malaria-control measures to make surveys, prepare estimates for malaria-control work, and furnish expert supervision required to carry on such work.
> 2. The State and local health authorities will jointly provide the necessary funds to cover the cost of antimosquito control measures, and indicate the places where such control measures are to be carried on.
> 3. In instances where the State and local health authorities are unable to immediately provide all funds necessary to carry on the malaria-control measures indicated, the International Health Board will provide a certain percentage according to budgets approved by the parties to the cooperative agreement.
> 4. It is expected that, as soon as the value of the work is more widely demonstrated and the ultimate cooperative basis aimed at is attained, the antimalaria work will be carried on as a permanent feature of the cooperative health work of the governmental agencies, Federal, State, and local, without assistance from private agencies.

In considering service policy in relation to malaria-control investigation, it is necessary that we keep clearly in mind three fundamental facts: (1) The allotment under which we are working is made from the appropriation "Field investigations of public health"; (2) the feasibility of malaria control in urban communities by means of drainage and oiling has long since been demonstrated and therefore is not *per se* a proper subject for further investigation; (3) the allotment under which we are working is made for the investigation of all malaria problems affecting the public health and not for any one particular aspect of the problem. Since the malaria allotment is made for investigational purposes, it would clearly be illegal to spend this money for malaria control alone no matter how great the need of control might be in any community and it would just as certainly be unjustifiable to spend these funds in the investigation of malaria problems which have already been solved. Legislation has been proposed from time to time and has met with considerable support in both Houses of Congress which would enable the Public Health Service to expand its health activities and enter into an extensive cooperative program for the control of human diseases with the different State and local health authorities, similar to the Governmental cooperative program of disease control among domestic animals, but up to the present time Congress has not seen fit to authorize such governmental activities nor appropriate funds for such an extensive health campaign.

Demonstrations in malaria control were early recognized as one of the most fruitful fields of investigation, and some may consider that there is still a legitimate field for malaria-control demonstrations, such as were so successfully conducted by the service from 1913 to 1917. No doubt in certain communities presenting peculiar local problems, demonstrations would be perfectly justifiable in order to investigate the peculiar local problem, but any widespread plan of malaria-control demonstrations might be easily extended to include every community in the United States in which malaria is a health problem without increasing our present knowledge of malaria control in the least.

In my judgment the service policy in malaria-control investigations is clearly indicated in the memorandum prepared in the Surgeon General's Office at the inauguration of our program for cooperative malaria work. This policy is contained in the first sentence, which reads as follows: "In order to promote the control of malaria and to accelerate the conduct of this work by the properly constituted authorities," etc. It is perfectly clear in my mind that the investigation of these two subjects is the only justification we have for the expenditure of Government funds under the cooperative malaria-control program.

Every effort has been made from field headquarters to impress upon the field directors the importance of this policy and necessity for making an investigation out of the control measures which are under their direction. It is easily understood how a field director might become so enthused over the success of the drainage and oiling operations immediately under his direction as to lose sight of the ultimate object sought in these control investigations. It is also granted that unless the control work is properly done we can have no hope of promoting or accelerating local effort in malaria control; but unless the field director goes further than a successful demonstration and employs every effort in investigating measures which promise the continuation and expansion of the work under his direction by the State and local health authorities and its grafting on to the regular health program of the community he will have fallen far short of what is expected of him and will have wasted time and misspent money which was appropriated for an entirely different purpose.

Another matter which we should consider briefly is that our allotment is made for the investigation of all malaria problems and the field being so large and the funds so small, only the most important and most pressing problems can be investigated at any one time. The importance of these problems may vary from time to time. Some will be solved, others altered, but it has been the policy of the service to undertake first the investigation of those problems which seem to promise the greatest practical results in decreasing malaria sickness and at the same time to carry on what we have termed purely scientific investigations. The line of separation between the two classes of investigations is neither fixed nor very definite; but under the first head may be grouped demonstrations and investigations of malaria control, and under the second all other laboratory and field investigations.

As stated above, the grouping is arbitrary, but it seems natural in many ways. It is frequently difficult to determine just how much of an inadequate allotment should be spent under the first head and how much under the second. During the first three months of the present fiscal year approximately $15,000 was spent for the investigation of malaria control by the service and approximately $6,000 for the investigation of all other malaria problems. It may be questioned whether this is the wisest division possible of our expenditure under the allotment.

In the beginning service-malaria investigations were conducted with a divisional headquarters first in the marine hospital, Mobile, Ala., then from the marine hospital at New Orleans. This arrangement was made both for the convenience of the medical officer in charge and for reasons of economy. During the war emergency the administrative duties at field headquarters were reduced to a minimum and the office was practically left in charge of a competent clerk. The actual direction of malaria-control operations in the extra-cantonment zones was conducted in person in the field by Dr. Carter, Dr. Derivaux, and Mr. Le Prince. In 1919 the malaria field headquarters was moved from New Orleans to Memphis, Tenn., and separated from any other service station. The increased allotment for malaria investigations which was made at that time and the cooperative agreement which was entered into with the different State health authorities and the International Health Board made possible a great expansion of malaria-control investigations. The number of officers engaged in these investigations was greatly increased and being widely separated in their assignments (Virginia to Texas) it was natural that the administrative duties at field headquarters should be similarly increased.

In carrying out these duties it has been the sole aim at malaria field headquarters to interpret correctly service policies and bureau instructions to the field force—to direct and correlate their investigations, to spend our allotment to best advantage, and to build up a field force of malaria investigators and an administrative system which can be readily expanded to meet such future demands as increased allotments may make upon us.

The bureau rightfully insists upon having definite reports at stated intervals of the progress which is being made in malaria investigations and of other administrative matters; otherwise, the expenditures can not be justified to Congress. It has certain forms for these reports, definite rules for official correspondence, and printed regulations for the government of us all. The officer who makes no attempt to conform to these rules and regulations does not fit into the organized disease-fighting forces of the Government. And we who are engaged in malaria investigations belong to these forces because the final goal of all our investigations is health improvement. In order that we may work together to best advantage in obtaining this end, each and every one of us must perform the duties assigned to him to the best of his ability, remembering that we are all members of the same body and all working for the same end—*the investigation and solution of malaria problems.*

DISCUSSION.

Mr. LE PRINCE. I think we are clinging too closely altogether to a procedure that was started 20 years ago. Back in the eighties Dr. Howard taught us all the value of oil in connection with mosquito control. The general scheme of malaria control and mosquito control was developed in the countries to the south of us, and we are following those lines too closely altogether; there is too much handwork done; we haven't looked into the possibilities of other methods of control as closely as we should have done, and personally I am of the opinion that our mosquito-control work is becoming altogether too expensive. The mere fact that the public is ready to pay for mosquito-control work is not a sufficient reason why we should continue our present methods; we must have more economical and more satisfactory methods of procedure, and I think everybody should keep that point in mind.

I understand this past summer we have paid as high as 25 to 27 cents per gallon for oil that formerly cost from 4 to 7 cents per gallon. Labor cost is double and worth about half as much, so that I might state to-day we are getting from one-third to one-half in the way of a day's labor of what we used to get.

We must consider other methods; we must find if in a large part of this country we are not doing altogether too much ditching for malaria control. There may be certain parts of our work that may be omitted altogether. Investigation along that line is necessary. And I think that it is necessary for our service to consider possibilities along this line. If that is done, there will be as many of the service engineers available for field work along demonstration lines as there has been in the past. It is certainly necessary to keep down costs, and I think everybody should keep that idea in mind.

Any further discussion?

Mr. Rose. I don't know that I have any place on this floor, but I can't very well restrain myself from giving emphasis to the importance of the point that has just been made.

If we are ever going to succeed in this work, it is just as important to give attention to the dollar as it is to the mosquito; to the control on the one side and the cost on the other side. The question how can we cut expenses is important. The man who can devise a means whereby he can diminish the cost of this work has made a contribution that will be valuable to the work everywhere.

Dr. Ferrell. Mr. Chairman and gentlemen, Dr. Fricks has outlined quite clearly the plan of procedure which has guided in the cooperative demonstrations for malaria control during 1920.

A program for 1921 is being formulated. Those of you who have actually engaged in the work should be in a position to suggest modifications and changes which should be made. Perhaps you can suggest changes which will increase the efficiency of the work, lower the per capita cost for control measures, and permit the employment of a larger supervising personnel which may find continuous employment in public-health work directed to malaria control.

The 1920 plan for financing the cost of antimosquito measures contemplated the securing of as large appropriations as could be obtained from the towns, and that the remainder of the cost would be shared equally by the State board of health and the International Health Board.

The per capita cost of the work in six towns in Alabama averaged 80 cents, of which the towns supplied 40 cents, the State 20 cents, and the International Health Board 20 cents. In three South Carolina towns the per capita cost averaged $2.95, of which the towns paid $1.53, the State 71 cents, and the International Health Board 71 cents.

In Arkansas, Texas, and Tennessee the State boards of health had no available funds for the work, consequently the towns were called upon to supply a larger percentage of the cost for antimalaria work. The average per capita cost in 4 Arkansas towns was 57 cents, in 2 Tennessee towns 85 cents, and in 12 Texas towns 64 cents.

There seems to be some correlation between the per capita cost and the amount of money contributed by the State board of health for antimosquito measures.

One naturally inquires why the per capita cost runs high in certain States and low in others; and whether or not the results are determined in any degree by the amount of available funds from the respective agencies. In any event, it would seem desirable to shift as large a part of the cost for antimosquito work to the towns as possible, so that the available funds of the State for the work may be used in strengthening the personnel and in an extension of the work.

I feel sure these discussions, together with a review of the work throughout the South for 1920, will prove stimulating, and that we shall be able to bring about a number of improvements next year.

Mr. LE PRINCE. A suggestion was made to me last night that it might be possible, in case of shortage of supervising engineers, for the towns themselves to bear a part of that burden. If they employ an engineer to do their work from other sources, as his term of service would be short, they would have to pay him a very much higher sum than the actual cost of the engineering supervision as now provided.

An expression of opinion from some of you that make the approach to the different towns will probably be more valuable than anything by me, and on this matter I think the State health officers can give us some very valuable information as to 1921 possibilities.

Mr. CLARKE. I made about 10 surveys in the hill section of Mississippi last year. I found that where the conditions were bad and good results could be had at small cost, we could get at least 75 per cent from the towns.

Now, I think, especially in the Delta territory which we will take up during the next season, that no doubt we can do as well as we have done in the hill section; because the work is greatly needed and will not be costly in the majority of cases. And, further, I believe that we could educate them up to the necessity of the work within three years so that they will put up 100 per cent, and the State board of health and the cooperating agencies would have only the overhead cost to bear.

Mr. LE PRINCE. I would like to hear from some 100 per cent men, those who have had the towns pay everything. There must be something in this manner of approach that could be brought out that will be worth while. Will some one of the engineers who has got the towns to pay all of the funds please give us some information as to the general method of approach, procedure, and so on?

Mr. MAGOON. I found that there was no difficulty in locating districts in Texas where the malaria problem was more than half of the health problem of the towns, and where local people could furnish all the money needed for the work.

There was sufficient time to make the detail surveys, and they were carefully completed in advance of the effort to have the agreements approved. All agreements were consequently signed without delay. It was necessary for one town to call in a banker and arrange to borrow the money for its campaign. Towns borrow money for sewerage and other things that are not as improtant as antimalaria work. This same town found it necessary to organize its work so that one full-time competent employee could be secured to look after the duties of tax assessor, tax collector, city marshal, street and bridge department, and sanitary inspection, including oiling and ditching. This year all revenues of this city amount to about $3,000. This must pay for the full-time city employee, for any teams employed, for part-time city secretary, and part-time service of a negro who cares for latrines. Obviously this town can not have a separate organization for each activity it should care for. The mayor and city council appreciate the fact that they should care for the health problem of the town. Their full-time city employee is instructed that his first duty is to care for the antimalaria campaign. While not engaged on that, he can take care of collecting taxes, putting up hogs, and other work of the city.

I believe the work of the director is to plan the work of the towns on such a scale that they can care for the antimalaria campaign and other essential work with the taxes that they may be permitted to levy. I believe the antimalaria work should be under the direction of the mayor and city council. The director should have nothing to do with time keeping, paying labor, and like responsibilities, but his duty should be to teach others what should be done, and plan the drainage work so that all the activities of the town can be carried on with a reasonable expense assigned to the antimalaria campaign.

Dr. FERRELL. Do you feel yourself at any great disadvantage in approaching these towns and being unable to offer them a certain amount of money as coming from the State board of health?

Mr. MAGOON. I found that I was at no disadvantage because I had the assistance of Dr. Harrison, one of the members of the Texas State Board of Health, who was so gracious in his explanations to the town in regard to my efficiency in the work that they were glad to make plans so that they could get my services.

Dr. HARRISON. It might be of interest to briefly outline our experience in Texas in organizing this work.

The work was first attempted officially during the last season, and, as Dr. Ferrell has stated, the State board of health was without funds to place at the disposal of this work. But we were assisted by the International Health Board and the Public Health Service. Then we started the actual work of organization, and in placing the proposition before the towns it was our intention to have the towns bear the entire expense of the work, except that of supervision, which was to be furnished them. That was the proposition that we made the towns. In Mr. Magoon's units we were more successful with that plan than in the other two units. The towns pledged themselves to bear the entire expense of operation, and they did so. The work was very successful, and those towns will continue to work during the coming year, supporting it entirely, with the exception of the supervision.

In Mr. Parker's unit we also made the same proposition; the towns pledged themselves, through the officials, to support the work in the same way. When we began actual operations we found that the towns hadn't sufficient money to carry on these operations except by asking for public subscriptions. They were only partially successful in that. One town did support the work entirely; the other three towns couldn't raise the funds even after pledging themselves to do so. It then became necessary to ask further assistance from the International Health Board. It was given to us.

In Mr. Hardenburg's unit the same proposition was put up, and the towns pledged themselves to raise the funds. The towns all carried out their pledge in his unit, but unfortunately it was found that there had been a slight underestimation of the cost of the work in that unit. It therefore became necessary to ask for assistance in his unit. It was also granted. That was the general status of the organization work.

Speaking just for a minute of plans for the future, we feel very strongly in Texas—and I am sure the cooperating agencies agree with us—that to make this work permanent it should be borne to a very great extent by the towns themselves, and we are planning not to organize any new work in Texas except on that basis.

In regard to increasing the appropriation for the work, we will not be able to obtain a regular appropriation from the legislature until next September. However, the legislature meets in January, and we have drafted a bill for an emergency appropriation of $56,000 to expand our work.

As I stated yesterday, we have 105 counties in the malarial belt of the State, and we have been simply deluged by requests to extend this work. Therefore we have a very great problem to handle, so we intend to ask for this emergency appropriation. We also hope that this appropriation will enable us to employ sanitary engineers who will be paid by the State. In addition to that, naturally we want as much outside assistance as we can obtain.

I am very proud of the fact that Dr. Ferrell has mentioned that control work has been carried on in Texas at a very low per capita cost—I believe 64 cents.

Dr. Hayne. I am deeply interested in this subject. I listen to these statements and figures and I don't know at times where I am at. One man will say that the per capita cost of the control of malaria is 50 cents in a town, and that is compared with some other town in which the per capita cost is as high as $12.50. Is he talking about the same thing as I am talking about, or am I talking about an entirely different proposition?

I want to bring out a few figures. We had in South Carolina a little town of 2,200 people, and they had malaria. They had plenty of it; and it wasn't necessary for an investigation to determine whether they had malaria or not; they admitted that they had it. They had reported 600 cases at one time, and the probability is the unreported cases would have amounted to at least 1,500 of the 2,200 inhabitants. Now, that is malaria, and that is a town that is interested in getting rid of malaria. In Bamberg, S. C., we had about 7 square miles of territory, requiring 52 miles of ditches. Some of these ditches were regular ship canals. This town of 2,200 people had to put up about $17,000 of its own money in order to have this work done.

Now, we had other little towns, probably like the ones referred to, where we got along with 50 cents. Those towns didn't do anything that I know of except clean out a few ditches and do a little oiling, etc., and they decreased malaria to some extent. In this comparison of per capita costs let's have some standard to go by.

Now, as to whether you are going into the town and say, "You do all of this work and we will supervise it," or whether you say, "You put up half the money and we will put up the other half," depends on whether you have any money to offer. Of course, if you don't get any appropriation from the State board of health for malaria work, naturally you have to go to the towns and say, "You put up the money; I can't help you in any way." The only thing left for the town is to put up all the money. But these towns knew as well as we did that the State board of health had put up some money, and they wanted their part of it.

Now, our program in South Carolina is this: We propose to have a malaria division under the State board of health, with a competent engineer at the head of it. We believe that it is largely an engineering problem; we believe that there are some medical problems that enter into the control of malaria, but we believe that we have enough medical knowledge in the State board of health to supply the necessary medical knowledge to the engineer, so we are not going to put a doctor in charge of a division that will be almost entirely engineering work. We propose to ask our legislature for an appropriation of $15,000 for this work. It is a large amount of money for South Carolina. South Carolina is a little bit of a State; probably it has 700,000 white people in it, and the Negroes don't pay taxes. Get that in your head when you talk about the amount of appropriation.

We are faced in the South, if not all over the United States, with a period of extreme stress—a period when you can not get hold of money under any circumstances. I know of several instances in which men have gone to banks and offered to pledge their Liberty loan bonds and couldn't borrow 5 cents on them. Those are the conditions in my State. Now, when you talk of increasing appropriations under those conditions, the legislatures would be derelict in their duty to their citizens if they put an extra tax on them.

What we want to do is to tide over this period of 1921 until we get back into a period of prosperity again. To do that we are going to have to call on the International Health Board to tide us over 1921 in this malaria work. If we are going to do anything in 1921, it will be to hold what we have and not do very much more.

We have three towns that have agreed to continue the work which we have done, and we will have to have a competent man to tell them what to do and to see that they do it. Then we propose in two or three towns to do the same work, but not this intensive kind, where we picked out the most malarial place in the State, and it cost $12.50 per capita, and it was worth it.

Dr. GARRISON. I think we are going to be confronted with many difficult problems with reference to securing appropriations, certainly from our legislatures. There are some of our old towns that are going to continue the work. Some of them may have to be coaxed a great deal; some of them may have to be assisted. I think the engineers who have been doing that work probably can answer that question now better than I can. Most of the towns have made promises, but my experience this year has led me to come to this conclusion: That unless they put up the money by the time work is to be begun in the spring we will not begin control measures. We have had some experiences this year which we don't wish to occur again in 1921.

I can't very intelligently discuss that question of administration because I did not hear it, but I think that we are all pretty generally agreed as to the plan of procedure. As to the agreement between the various agencies, there is one thing that seems to me must be definitely determined at this time, namely, what personnel can be guaranteed to the various States. I want to know that, if possible, now.

We have been asked to make surveys and I have written letters to additional units stating that preliminary surveys would be made for work in 1921, free of charge. Some of them have answered favorably; some of the surveys have been made and they report they are going to raise the money; others that they are going to try to raise the money. That is a very good report, and it is encouraging, but unless they do put up the money we are not going to undertake new work.

I want to know what to offer the old towns next year. I did not have enough personnel this year to secure necessary data and supervise them. As a result the work has not been as successful in the way of mosquito control as it had been in the past, and for that reason we have received some criticism. I want to give you one of the instances. In the city of Eldorado the Rotary Club requested that a survey be made. It was made, an estimate of twenty-four hundred and odd dollars was submitted, and the Rotary Club underwrote that amount, the city agreeing to pay something like four or five hundred dollars. After a great deal of trouble and argument the appropriation was finally actually secured. The work was begun. Along in midseason the engineer was taken ill for a period of weeks, and we simply couldn't relieve him, and during this time the inspector did a great deal of ditching which was unnecessary and expended several hundred dollars that was unnecessary, which rendered our fund inadequate to do the job well. As a result the Rotary Club is dissatisfied and I am to be called on for an explanation.

Unless we can get definite information as to the number of engineers we can count on next year we can not make out our program.

Dr. FERRELL. You have 4 new towns this year, and you had 10 towns under control previously—14 towns in Arkansas up to date; is that correct?

Dr. GARRISON. Well, that doesn't include Little Rock, which isn't in the joint program.

Dr. FERRELL. Might I ask what you contemplate in the way of a legislative program in securing funds to enable the State board of health to hold what has been begun in these towns?

Dr. GARRISON. I contemplate asking the State for $10,000 annually for a period of two years, and I am going to ask the International Health Board and the Public Health Service to finance the rest. I don't know that I can get that $10,000. That is my program. If I don't get aid from the legislature I would like to know how much supervision we can count on, so that I will know how many towns we can supervise next year.

Dr. FRICKS. Mr. Chairman and gentlemen, I want to point out to you the danger of our marking time in malaria control in the small towns and not investigating every factor that enters into malaria control and the future expansion and successful continuation of our work. Mr. Le Prince and Mr. Rose have mentioned one, which is reduction in cost. Another factor, it seems to me, of great importance is the devising of some plan through which this work is grafted on to the permanent health work of the State and the community. Personally, I feel that in the South the county is sure to be the local health unit. I am not here to tell you how you are going to graft your particular line of malaria control onto the health program of the county. Mr. De Mott has shown you how it was done in Nassau

County, in New York State. I can't tell you how it should be done in any particular community, yet it has to be done if the work is to be permanent. I feel that if we hold fast to that which is good in quinine administration, fish control, screening, drainage, and education, and properly select and combine the control measures suitable to any given locality, we will be able to extend malaria control throughout the rural communities of the South.

Mr. Le Prince. The next paper will be on fish control, by Mr. Parker.

FISH CONTROL.

George Parker,
Sanitary Engineer, International Health Board.

For such a tiny fish the reputation and responsibility of *Gambusia affinis* are prodigious. Its rapid multiplication and insatiable appetite for mosquitoes in the aquatic stage render it of incalcuable value in field operations directed toward malaria control.

Much has been said regarding the life history and the ability of Gambusia to adapt itself to various conditions. This paper means to deal more particularly with such items of interest as have been encountered during the past season in antimalaria demonstration work.

The town of Athens, Tex., having a population of 3,704, was selected to demonstrate malaria control through the exclusive use of Gambusia.

The chief industries in this town are the manufacture of bricks and other clay products. During past years many clay pits have been abandoned, and, for this reason, with few exceptions, some 35 ponds have been created well within the town limits. Nineteen of these ponds are located on the western side of the town hardly 1,000 feet from the courthouse building, which marks the center of the town, and are surrounded on three sides with dwelling houses.

On April 30 the work of stocking all ponds was commenced. A total of 14,720 Gambusia was placed in the 19 ponds mentioned. Their multiplication was rapid, and few Anopheles were found breeding up to the month of June when the heavy vegetable growth was completely removed. Four of these ponds were entirely free from this growth, due to their peculiar white clay banks. Dry weather which followed served to reduce the volume of water in the ponds and the edges were entirely free from vegetation. Anopheles breeding was under control. Inquiry and observation proved that the mosquito nuisance had been greatly reduced.

The effect of this work is best demonstrated by the following extract taken from a written statement made by Dr. J. K. Webster, city health officer, on September 1, 1920:

> It is my observation that although there is more malaria in Athens this season than in previous years there has been but very little in the area of mosquito-control work. In fact, in my own practice I have had no call to a case of malaria within the area of the work done.

The preliminary survey of this town developed the presence of Gambusia in three bodies of water: One shallow pond on the southern border of the town, a large pond 1 mile north of town, and in a slow-moving stream, running northwest from the last-mentioned pond. This stream received the discharge from the septic tank, and at a point below this discharge, the largest quantity and best specimens of the fish were found.

It is well known that Gambusia seek out their own habitat when at liberty to do so, and in this instance they showed a marked preference for the stream leading from the septic tank. They were found in the small shallow overflows of this stream that contained the same class of water, and also in the stream bed where their presence could not be distinguished, except by their movement, on account of the color of the water. These fish were the largest and best specimens found and withstood rough transportation well.

In Jacksonville, Tex., a town where complete antimalaria measures were resorted to during the past season, Gambusia were used entirely to control Anopheles breeding in ponds, with the same result as prevailed in Athens. Some experiments were carried on at this point. Stock ponds provided with Gambusia were rendered entirely free from Anopheles breeding during the season, though water held in cow tracks at the edges of the ponds was a continual source of breeding and required constant attention.

In one lake the Star Head minnow, presumed to be *Fundulus nottii*, was present in a quantity considered sufficient to control Anopheles breeding. The edges of the lake were cleared of vegetation and the action of the Fundulus observed over a period of six weeks. Anopheles breeding continued and increased rather than diminished, though the breeding was not prolific. The lake was then stocked with Gambusia, and in a very short time Anopheles breeding was under control.

A Gambusia hatchery was established in this town early in the season. The Gambusia were collected from points ranging from 1 to 5 miles from the town and placed there to breed. Other ponds and lakes were either stocked from this hatchery or the fish placed in them when brought to town. The latter method seems to be the best to follow, especially when the collecting is being done early in the season, in order to allow the fish to multiply throughout the year where needed and reduce the original number necessary for stocking at a later time. A hatchery should, however, be maintained for other reasons. For instance, ponds and sluggish streams located a sufficient distance not to be considered a menace to the town from a point of mosquito flight, yet having their relative importance to the town, can be stocked from a hatchery, and the rural communities provided with these fish at will.

The effect of Gambusia on Anopheles has been mentioned in this paper, but so far the Culex has been given no consideration. Several observations along this line made during the season are worthy of mention.

The Gambusia hatchery in Jacksonville remained in first-class condition during the entire season. In no instance were the banks at the water edge grass grown. Repeated inspections were made for mosquito breeding in the pond. Never were Anopheles larvæ found, but on several occasions full-grown Culex larvæ were present. In two ponds to the south of this town, far enough from the area under Anopheles control to require no clearing, and with grass-grown edges, except for a few weeks during an exceedingly dry spell, Gambusia were placed toward the middle of the season. Anopheles larvæ were few after this period, and only occasionally was an Anopheles pupa located, while a branch and small pools a few yards distant contained them in abundance. The ponds contained Culex larvæ and pupæ throughout the season. This condition occurred in several other instances, including the ponds stocked with Gambusia in Athens. The places under observation were known to be adapted to Anopheles breeding, as the presence of this mosquito was marked prior to stocking with fish.

I do not mean to say that Gambusia will not eat Culex larvæ. In small glass bowls it was demonstrated that they do, and like them. This was also demonstrated in a section of ditch that remained wet after the greater portion had dried. This section was several hundred feet in length and about 3 feet wide. It contained prolific Culex breeding and hardly any Anopheles. After stocking with Gambusia the Culex breeding was practically eliminated in a few days.

Anopheles and Culex larvæ were put in a small glass bowl in equal numbers, with Gambusia, and the Culex were eaten first. This is attributed to the fact that the water was clear, and the fish, remaining below the surface, saw the Culex first as they dived for protection, while the Anopheles remained on top of the water near the edge of the glass bowl.

It may be said that Culex breed more prolifically than Anopheles and that this would be the explanation for my observations. I believe that it has something to do with it, but in stressing the point I think the Culex obtain better protection under natural conditions from the Gambusia, swimming at the surface, because they dive and are able to elude them by hugging the bottom in shallow water, while the movements of the Anopheles are visible at the surface.

As a natural enemy to the breeding mosquito the *Gambusia affinis* can not be overestimated, particularly in its action against the malaria-transmitting mosquito, Anopheles.

DISCUSSION.

Mr. LE PRINCE. I want to call upon Dr. Howard, who has done some very good fish-control work in Mississippi, and probably at other points in the past, to open the discussion of this paper.

Dr. HOWARD. I have heard Mr. Parker's paper with interest and satisfaction—with interest because it was very instructive, and with satisfaction because it confirms my faith in the Gambusia as a very valuable ally in mosquito control.

Since 1917 I have had in charge a rural area in Mississippi consisting of about 36 square miles, where we have been experimenting with the Gambusia as an agent of mosquito control. The area is purely rural in nature and has a population of 600 people. It is in the hill section of Mississippi, where corn and cotton are the main products, and where the usual methods of cultivation are employed.

In 1917 and 1918 our activities consisted entirely of making observations and studying natural conditions. During this time it was noted that the Gambusia was already actively functioning in many water deposits under natural conditions as a control agent in mosquito production, and it was early determined to employ the Gambusia as extensively as results would justify in our plans for mosquito control.

At the opening of the season of 1919 control measures were instituted consisting at first of drainage, training of ditch and stream channels, clearing away of vegetation, débris, edging, etc. Water deposits which could not be permanently disposed of by drainage were prepared and stocked with fish. At first some oil was used, but later the fish supplanted the use of oil almost entirely, so that by the end of the season of 1919, 90 per cent of all water deposits in the district were being successfully controlled with the fish.

During the present season (1920) we have maintained mosquito control in a like proportion of our water deposits with fish alone. As the season of 1920 opened we found that the majority of water deposits stocked with the Gambusia in 1919 had retained their complement of fish through the winter, and only about 8,000 fish were necessary to restock the entire area during the season of 1920.

In practically all of the water deposits of any size and of a permanent nature, the only work required during the season of 1920 was the clearing away of débris, falling leaves, and vegetation, to expose the mosquito larvae to the fish. In the district referred to there were 228 classified water deposits consisting of lakes, ponds, creeks, ditches. pools, potholes, dipping vats, cisterns, and springs. All classes of water deposits were stocked with the Gambusia with uniformly good results.

Our experiences and observations during the three years of our experiment convince me that in those sections of the South where the Gambusia is indigenous, or in any section where it may thrive, it can be employed to great advantage in mosquito control, and I know of no agent of control which will function satisfactorily with so little supervision and preparation of the individual water deposit.

With reference to the occasional breeding of mosquitoes in water deposits stocked with the Gambusia, our observations agree with the statement made by Mr. Parker that it is the Culex which is most often found, the larvæ of the Culex seeming to be more often able to escape destruction by the Gambusia than the larvæ of the Anopheles.

Mr. Le Prince. It is one minute of 12, and this discussion will be continued this afternoon. The meeting is now adjourned until 1.30.

Afternoon Session, November 16, 1920.

Mr. Le Prince. I am going to call on Dr. Griffitts to continue the discussion on fish control. I know perfectly well, particularly on the Texas coastal plain and other sections, the fish are giving us very satisfactory results, but I want to know about places where they are giving poor results and what it is due to—whether you run across places where the Gambusia are unsatisfactory and just what the difficulties are, and any other pertinent remarks you wish to make.

Dr. Griffitts. Mr. Chairman, I have had no experience and no observation of places where Gambusia are useless. I believe they are of use wherever they occur, and that they have been an important adjunct, or ally, as the term was used by one speaker this morning, in keeping down malaria naturally; and in many instances they have been put into places where they have done valuable service.

One speaker referred to his relying upon fish control solely. I don't know of any place or any body of water in any part of the country where vegetation will grow where you can apply fish control solely. Probably on account of the peculiarity of the method by which they come into the world, the top-feeding minnow, in my estimation, requires " wet-nursing " in order to get it to do the things that we want it to do. The " wet nursing " consists in patrolling and cleaning your pond edges and in keeping them as near absolutely free as possible from vegetation and from floatage of different kinds in order that the top-feeding minnow may see the wiggle tail when it wiggles. I have seen Gambusia pass up to and actually touch the larvæ and not devour them until some motion was perceptible. The more floatage you have the less movement you are going to have on the part of the larvæ. I have never observed, except in artificial containers, the attack of the top-feeding minnow on larvæ except when the larvæ moved.

Some of the worst breeding places of Anopheles that I have ever seen were bodies of water that were well stocked with the top-feeding minnow—naturally stocked—where the vegetation was of such a character as to afford hiding places, and the wiggle tails would not be attacked by the top-feeding minnow.

For control of malaria about impounded water or hydroelectric power projects it is important to early establish fish hatcheries and to supply these large bodies of water with top-feeding minnows. This is relatively inexpensive, and it is very important work. I would like to stress its importance, because Southern State health officers, if there are any of them here who haven't had these problems, will have them come up. In a great many waters there are already top-feeding minnows and they can be increased in enormous numbers and transferred to the reservoirs.

I do believe that whenever possible in malaria-control work every pond should be unwatered by drainage if feasible because of this one fact: You must depend upon the local community to continue this work, and it is easier to keep places unwatered than it is to do this "wet nursing" for the top-feeding minnow that I spoke of. Whenever the use of minnows in mosquito eradication would in any measure discourage the drainage operations that are more or less permament and which the people will maintain better, I would certainly resort to the latter, the more permanent work.

There were several places in North Carolina where we did demonstration work. The Gambusia is naturally very prolific in those sections. We did some very good control work by cleaning pools and by keeping ditches clean for their action, and thereby cutting down oiling expenses, but wherever leaves dropped in the water, or the edges had not been sufficiently cleaned we invariably found Anopheles larvæ in various stages. You can not apply *Gambusia affinis* without also preparing your pools so that they can get around and do their work.

Mr. LE PRINCE. We will hear from Mr. Hildebrand on the subject of fish control.

Mr. HILDEBRAND. Mr. Chairman and gentlemen, in the main I agree with what has been said in regard to mosquito control by fish. However, the last speaker made a few remarks which do not agree with my observations. For instance, if I did not misunderstand him, he thinks it necessary to remove all vegetation from water in order to get 100 per cent mosquito control by the use of fish. This I don't consider necessary in a large number of conditions, depending in a large measure on the number of minnows that are present and the general biological conditions which prevail. I will come to that again a little later.

The reports this morning were certainly very pleasing to me, and I learned one thing that I hadn't observed, that the Gambusia is more effective in eradicating the Anopheles than the Culex. An effort will be made to verify this.

I was rather disappointed not to hear anything of the cost of the work at Athens, Tex. It may be that Mr. Parker didn't have time to bring that out, but if time is available I wish he would do that yet. No actual figures of any work that has been done with fish are available, but I can state that in the summer of 1918, with the help of one laborer all the time, and two laborers part of the time, a large series of ponds, probably several hundred, around Augusta, Ga., was absolutely taken care of. You can figure for yourself what the cost was as compared with other methods, and we had absolute control, but we spent more money and did more work than was necessary because we couldn't afford to experiment around the camp there. We didn't use any oil in any of those ponds on the Augusta side at any time, with the exception of treating large floating masses of algal pads. We at first treated these algal growths with copper sulphate, which worked very satisfactorily, but this was more expensive and slower than simply to oil the pads.

Now, just a word about the history of fish control. The first practical test of this method of control that I know of, on any large scale, was made at Dallas, Tex., by Mr. Van Hovenberg about 1916. In the spring of 1918, upon the request of the Public Health Service, I was detailed to Augusta, Ga., to do the work of which mention already has been made, and my superior officer expressed extreme doubt as to the practicability of fish control. His information was derived from the work done at Mound, La., situated in the Delta region, where the minnows are so generously distributed that there is scarcely a place where a comparison can be obtained of the difference in mosquito production when they are present and when they are absent.

In the summer of 1918 certain ponds at Augusta were stocked with fish and I think they have about reached their natural biological possibilities at this time. I made careful inspections there last August and there are less than a dozen ponds that we stocked in 1918 which, without having received one bit of help since 1918, do not have to-day 100 per cent mosquito control. Compare this with a certain pond in the same vicinity built since 1918, and therefore not stocked with minnows, and which had become largely overgrown with vegetation, yet not as badly as some of the ponds in which fish are present and where 99.99 per cent mosquito control prevailed. In making dips in the very densest vegetation in ponds where fish were established we probably didn't average one larva or pupa, while the new pond, which supported no fish, yielded from 25 to 100 larvæ in one dip. I presume that this is exceptional, but I am not here to state that that condition would not have prevailed in the other ponds if the minnows had not been present.

Now, I made some investigations this summer and have given particular attention to the distribution of Gambusia, and this interesting fact has come to my attention: That Gambusia is limited almost entirely to the malaria belts. For instance, in Austin, Tex., which is not in a malarious section, although some favorable bodies of water are present, only a very few top minnows were found upon an extensive investigation. The same is true at Atlanta, Ga., and at Nashville, Tenn.

The matter mentioned by Dr. Griffitts concerning the attraction of Gambusia by the motion of the wiggler is interesting and important. Gambusia does not seem to have developed good eyesight, for very often, as Dr. Griffitts said, it will nose a wiggler but will not take it, but the moment it moves that wiggler's life is lost. The range of sight appears to be limited to about 3 inches, and, of course, it is usually essential that we do not have too much vegetation to protect the wiggletails and to hide their movements. On the other hand, I have seen perfect mosquito control under the most unfavorable conditions imaginable with respect to plant growths. I refer to a lake at Perry, Fla. Mr. Foster will bear me out in that statement. I want to state, however, that we have at Perry, in addition to the Gambusia, another fish, the smallest American vertebrate, *Heterandria formosa.* Now, that may be a factor there, as it is much smaller than Gambusia, and I imagine it can get through and over vegetation where Gambusia can not go.

Mr. LePrince has given me a large amount of liberty, and I shall take advantage of that now. He told me to tell the sanitary engineers what they did that should not have been done and what they did not do that should have been done.

I was very greatly pleased with the general attitude of the sanitary engineers toward fish control, and I think that the Public Health Service can congratulate itself upon the able men it has. I found them extremely earnest and enthusiastic as a rule. Now, the main criticism that I have to offer is that insufficient time is devoted to inspections. I realize that the sanitary engineers have a great amount of work to do, and many things to attend to, but inspections, if they can not make them themselves, can be turned over to assistants in a large measure. We can not know what is going on in any body of water unless we examine it. I will say this: Before I would do any work on a body of water, such as cleaning out vegetation or floatage of any kind, I would want to know if it was necessary. Take the example at Perry, Fla. If Mr. Foster had attempted to clean out the vegetation from that lake, it would have cost hundreds of dollars and it would not have been necessary; but he simply kept on inspecting from time to time and found it unnecessary. A similar condition prevailed at Thomasville, Ga. However, later in the season it became necessary to give this pond a cleaning, but if the sanitary engineer had not been on the job and kept it under observation he would simply have said: "This is a bad place; we can not get mosquito control here without cleaning it." I was there in August and made an inspection. We did not find any large larvæ, but we found small ones. Mr. Old did find mosquito production there late in the season, and it became necessary to clean this body of water once.

That, I believe, is about all the criticism I have to offer, except that I might give an instance of some work that was done simply because time was not taken to see whether or not the work would be necessary. A certain pond, which I had designated a hatchery, was drained. It was a pond in which such conditions prevailed that I feel certain that not one mosquito would have come out of it the past summer.

The sanitary engineers may have their reasons for doing that kind of work, but if they are primarily concerned with the control of malaria, then such drainage work should not be done. Of course, if it is desirable to reclaim land, that is a different thing altogether.

Now, to make my position perfectly clear, I want to read just a few pages from a rough draft of a report that I have just written and which may be published in time. This report is subject to revision, and before we get through with the discussion this afternoon I desire to make some changes. I have tried to make myself clear, but still I found that somebody every little while says that this man Hildebrand claims that fish will do it all. I never made such a statement, for I thoroughly appeciate that fish control has its limitations. [Reading:]

Top minnows are of great value in controlling mosquito production in all permanent standing bodies of water, if in fact they are not the only agent known to date which successfully controls mosquito breeding in ponds and lakes. It has been demonstrated that top minnows are also very useful in sluggish ditches and streams, for at Savannah, Ga., all the ditches of the abandoned rice fields which supported top minnows, even though in many instances quite extensively overgrown with vegetation, were under almost perfect control during the latter part of the mosquito-breeding season of 1920, when the writer made inspections at frequent intervals. Identical results were observed under similar conditions earlier in the season of 1920 at Gulfport and Biloxi, Miss., Wilmington, N. C., and many other places. Minnows also are used in borrow pits, pools, potholes, cisterns, and shallow wells. It frequently is feasible to use fish more economically than oil in temporary pools and ditches, depending upon how near at hand a supply of minnows is available, and generally upon the length of time such temporary waters will remain. It probably seldom is practicable to use fish when the waters dry up in less than one month yet occasionally stocking a pool with fish is less expensive than one application of oil. Under such conditions it is an advantage to oil pools remaining even a shorter period than one month. The situation, with respect to the available supply of minnows and the cost of applying oil, in such instances must determine which method is the more practicable. It is sometimes an advantage to dig a pit in the deepest part of a temporary pool or swamp which may hold enough water to carry at least some of the minnows through a period of drought.

Top minnows may be used under at least the following conditions under which oil can not be used to advantage: (*a*) In ponds and lakes were a continuous film of oil can not be maintained because of being driven to one shore by wind action. (*b*) In waters used for drinking purposes, whether for man or beast, where oil is objectionable. (*c*) In places where there is tall vegetation which breaks the oil film, but which very frequently does not hinder mosquito control by fish. Conditions produced by plant growths, of course, exist under which absolute control with fish may fail, but under such conditions practically the same process of cutting and removing vegetation is necessary to secure control either with oil or with fish. Fish control being of a much more permanent character than oiling, therefore is preferable.

Fish control, aside from the cost, has the decided advantage over oiling of being very much more permanent in its results. Oil, as is well known, must be applied throughout the summer at intervals of from 7 to 10 days, and during rainy weather oftener, to secure mosquito control. The writer has not seen a permanent body of water where the fish were once established where they did not remain, unless killed or driven away by pollution. The many ponds at Augusta, Ga., which either were already naturally stocked or which were stocked artificially in 1918 were nearly all under perfect control in August, 1920, the fish, in many instances, having greatly multiplied, while in other ponds a biological limit of production probably had been reached in 1918.

The relative cost of mosquito control with fish or with oil for a single season has not been well established, for no data on somewhat similar situations have been collected, but it is evident that if top minnows are available in a given locality, and they are abundant almost everywhere in the malarious sections of the South, then the cost of fish control consists merely in distributing the fish, and, in some instances at least, the fish must be assisted by removing vegetation and floatage which furnish hiding places for the immature mosquito against fish. When oil is used, the cost of the product with present prices is a large item. The cost of distributing and spraying the oil at frequent intervals undoubtedly is greater than stocking the waters with fish in the same locality, under the average conditions obtaining in the malarious sections of the South, and the removing of vegetation and floatage is sometimes necessary whether using oil or fish. It, therefore, is quite evident that as far as fish can be used certainly the cost of the oil is saved by employing fish, with the further advantage that the mosquito control obtained with fish is not limited to the first season but will continue indefinitely.

Conditions, of course, exist when oil can be used to advantage and when fish are worthless. Fish, of course, can not be employed where a mere film of seepage exists or in footprints, and it frequently is not advantageous to use fish in very temporary pools, ditches, and swamps. Top minnows frequently do not work well in swiftly flowing creeks which, however, have quiet coves and pools. It therefore, because of the small cost and the more permanent results, seems advisable to use fish under all conditions under which they will provide mosquito control and to apply the oil treatment only when fish can not be successfully used.

Drainage undoubtedly deserves first place among the measures of mosquito control because of its permanent character, but it is a recognized fact that all water deposits can not be eliminated. The cost of drainage is usually high and therefore in many localities prohibitive. It is not always possible to replace control by drainage with fish, i. e., when the breeding areas consist of waters which will not support fish, but it is quite feasible to employ fish in all permanent standing waters which are not polluted or overpopulated with large predaceous fishes. Fish control is especially recommended for rural sections and for other localities when funds for the more expensive measures are not available. Certainly a great reduction in malaria can be obtained by the judicious distribution and protection of top minnows.

Dr. GRIFFITTS. I would like to ask what method you employ to transfer minnows from one pond to another. Also has it been your experience that lily-pad ponds don't produce Anopheles, as a general rule, in sufficient numbers to be of sanitary importance?

Mr. HILDEBRAND. Dr. Griffitts's first question relative to the transporting of top minnows: I have used lard cans frequently, although the standard method seems to be milk cans. The lard can is preferable to the milk can in some respects, although it is harder to handle in shipments. The amount of water you should use and the number of fish to carry is a thing regarding which each man has to use his own judgment. If the weather is hot, you should not carry over 50 minnows in a 60-pound lard can, but if the weather is cool, I think you would be safe in carrying, say, from three to five hundred. The weather conditions must govern very largely, and, of course, the temperature of the water is the important thing. We have had heavy losses in transporting fish, and again we have transported large lots and lost practically none. Also it seems that weather that is hot and sultry, particularly when there are showers, is a bad time to transport fish. You should transport fish either at night or on a cloudy day.

As to the lily pads, where we find them along the surface of the water, they will not do any damage; but some of the reeds are constantly dying, and ofttimes they form a clump which can not be reached by fish. When that condition prevails the lily pads must be removed, and I think that ordinarily this can be done at a small cost and probably it would be advantageous to do it at once; but I have seen instances where it was very expensive, and individual conditions would have to govern.

Mr. CLARKE. I would like to ask what are the chief enemies of the *Gambusia affinis*.

Mr. HILDEBRAND. The worst enemy of all is the fish that is generally known in the South as fresh-water trout, in the North, the large-mouthed black bass. From observations that I have made it isn't the adult fish so much that does the damage as the small ones that venture into the shallow water; for instance, a large-mouth black bass from 3 to 4 inches in length. Pike and pickerel also feed on fish. I think more important enemies are the water snakes. I believe it is advisable to kill the water snakes just as far as possible around the ponds where we wish to establish fish control.

(The conference gave Mr. Hildebrand a rising vote of thanks.)

Mr. ROPES. Mr. Chairman, I would like to say in defense of the engineers that one reason we have for draining places such as Mr. Hildebrand mentioned is because it is obvious that fish control will not be permanent. I have had perfect fish control in several borrow pits, but grass has now begun to grow around the edges. Now, next year, when I won't be there, there will be grass all around the borrow pits, and although fish control is perfectly adequate this summer it will not be so next year.

We had a great many Gambusia in Arkansas this year and we found them perfectly effective wherever the vegetation was kept down. Just as soon as this is omitted, so that the Anopheles are protected from the fish, there is plenty of breeding.

Mr. STROMQUIST. My work in the field, by personal association, has given me the greatest admiration for two individuals: First, Mr. Le Prince; second, Gambusia. We had in a town of about 6,500 population in Tennessee an appropriation of $5,000 for this season's work, out of which we saved $2,700. The difference between the actual cost and the estimated cost is entirely due to the presence of Gambusia, and I think it doesn't quite coincide with Dr. Griffitts' statement about Gambusia not being suitable for lands that are overflowed, because our great problem was river bottoms, which during the winter are overflowed, and when the water went down it left a number of sloughs and ponds, which were well stocked with Gambusia, and we didn't do a foot of ditching there.

Last summer I was called to a little village about 20 miles from Memphis. At this village there was an artesian well overflowing into a stock pond which in turn overflowed into a pasture. There were about 2 or 3 acres of this pasture covered with water up to 6 inches deep, with such a dense growth of grass that the water could not be seen. I dipped quite thoroughly at this place, and in a great number of dips found only three or four Anopheles larvæ, but in several dips caught Gambusia—sometimes as many as three in a dip. I think the Gambusia provided effective mosquito control at this place.

Mr. VAN DINE. The work on fish at Mound, La., has been mentioned. We must be careful not to compare investigation with control. Our conditions are these: We have a typical swamp country; we have these fish universally distributed; there is an universal production of Anopheles and we have a prevalent rate of malaria.

The fish are undoubtedly one of the greatest natural agencies that we have in mosquito control, and it is a big point to take hold of that agency and make use of it wherever possible.

The investigation at Mound was an attempt to see what reduction occurred in that environment. We failed to measure their usefulness, but I would certainly hesitate to take the responsibility of removing those little fish from that environment. No one can estimate their effect on production of malaria mosquitoes in that region, but the conclusion is that such reduction is not sufficient to prevent universal density of Anopheles sufficient for prevalent transmission of malaria.

Dr. Griffitts, in speaking of the use of these little fish in ponds, makes the statement that wherever the pond can be drained that would be the method of choice. In the work that Dr. Howard mentioned in Mississippi there are a large number of ponds where it is not practicable to either drain or oil. I refer to the stock pond, a farm necessity. Those ponds must be maintained, and it seems to me that drainage is out of the question in a country where those ponds are typical.

Fish control is not only an adequate solution, but the only practical solution for these stock ponds.

There is one biological point that I want to suggest in regard to the enemies of the top minnow that I have not heard mentioned. The predaceous fish are not to be regarded from the standpoint of the reduction of the little fish, but viewed in the light of the police patrol work on their part in keeping the little fish where they belong. Now, as an example, we have a certain body of water with a certain number of these little fish and we have certain results, yet in that same body of water if you have a given amount of other predaceous fish you get an increased amount of control. These little fish, instead of wandering about wherever they want to go—sometimes the very place they ought not to go—will be right where they belong along the margin. Their salvation depends on being there, and when you get differences in results under the same conditions it may be that the presence or absence of the predators would explain it.

Mr. **Magoon**. Mr. Chairman, this last summer I found it possible to control Anopheles breeding in 55 ponds with very little cost for labor. In fact, but few of these ponds required having the edges cleaned, and it was not necessary to clean the edges of any pond more than once during the season. Inspection of ponds on the 5th of November indicated that the fish control was still satisfactory. Gambusia were alert in getting any Anopheles that were collected elsewhere and put into the water. The unexpected effectiveness of Gambusia control was an important reason why the cost of mosquito control in four districts averaged less than half of the estimates.

Mr. **Fuchs**. I should like to call the attention of the engineers here, and Mr. Hildebrand, to a situation where drainage was cheaper and more effective than fish control. In North Carolina we had some ponds that were very shallow, whose banks had a very gradual slope, so that even a slight rain would increase the area of the pond tremendously, and a slight evaporation would decrease it very much. The result was that between the period of high water and low water—these periods came frequently—a great deal of vegetation grew up along a wide shore area, so that any attempt to clean the edges of those ponds would have resulted in a cost that would have been prohibitive when compared to drainage work. In these cases I preferred drainage, which would once and for all take care of the ponds, to the use of fish and the cutting of vegetation. I found that the vegetation in many such cases was so thick that Gambusia could not thoroughly take care of the Anopheles breeding. This is just one of the situations where, from a viewpoint of cost, drainage is preferable.

Mr. **Le Prince**. I would like to hear of some similar occurrences to that reported, in places where fish have been unsatisfactory. Those who operate in sections where fish are decidedly satisfactory must realize that there are limitations that are met sooner or later.

Mr. DAVIS. I agree with Mr. Hildebrand and the others that fish are probably our best natural help in the control of mosquitoes.

The area that Mr. Hildebrand referred to in Savannah, early in the season, was a prolific breeding place of Anopheles. After the vegetation was removed and the water confined to the ditches the fish controlled breeding absolutely, even though later in the season a rather dense growth of vegetation covered the ditches almost completely.

In another part of the town we had a large drainage canal with an entirely different class of vegetation. It is well stocked with fish, but we found Anopheles breeding in abundance. It was necessary to remove this vegetation twice during the season to allow the fish to do the work satisfactorily.

Dr. GRIFFITTS. Mr. Chairman, I want to talk just one second on the political relation between fish control and your local problems. What I mean by the political nature of it is this: Are the people going to be satisfied with a lot of eyesores, a lot of roadside pools and ditches, that they think they are paying for the drainage of, and on which they may get the impression that the engineer is out fishing instead of working? These are bad looking places. I don't care if you clean them a half dozen times a year. There may not be a single wiggletail in there all summer long. We must think of the impression it is going to make on those people, when we go in there and say "We will ditch or fill these places," and then we fail to do so, but depend on fish control, which the people don't see. That is one point that we all ought to bear in mind. People drive along the road and say "There is a place that the engineers left."

Mr. STROMQUIST. I agree with Dr. Griffitts that we must often consider the psychology of the people we have to deal with. At Brownsville, in taking up subscriptions for their part of the work, one man said to me he wasn't going to pay any money to these fellows to go fishing, and the first work we did there was draining a pond which possibly might have been controlled with minnows, but I am not quite sure they would have been entirely effective. It was located right in town only two blocks from the courthouse square, and it has been an eyesore to the people for years and the cause of a good deal of controversy with the owners of it.

Mr. VAN HOVENBERG. I would suggest that one of the best ways of enlisting the help of the children, such as the Boy Scouts, would be to establish aquariums in the prominent store windows throughout the town, and by teaching the Boy Scouts the practical value of Gambusia in the streams.

Mr. PARKER. In regard to the cost of the work at Athens, in answer to Mr. Hildebrand's question, the contemplated campaign was estimated to cost about $3,000, which amount the town was not in position to pledge, so we decided to put on a campaign of fish-control. The total amount expended, including help from the Cotton Belt Railroad, was probably $800. In areas outside of towns under control Gambusia were placed in ponds and no clearing attempted. In such places I can safely say that we got very close to 80 per cent Anopheles control. There was a growth of Bermuda grass along the edges of those ponds which was very thick and hard for the fish to penetrate, so I think it would be well to consider what effect the Gambusia have on a pond before the vegetation is cleared away. They will give at least 75 per cent control unless conditions are very bad.

That is a method I had in mind of reducing the expense of the work. As considered from a standpoint of mosquito flight, I think we can control communities very easily by the use of Gambusia. In a great many instances Gambusia placed in sluggish streams are carried on through the county, as I found them in streams 10 or 15 miles away from where I placed them in the headwaters. They washed down stream and gave a certain measure of mosquito control in different parts of the county, which cost the people in those sections absolutely nothing. The use of fish is one way in which work can be extended through the county at practically no cost with a good measure of mosquito control.

Mr. Le Prince. I would like to have a few remarks from Dr. Barber.

Dr. Barber. In the course of observations in the Southwest last summer my chief impressions regarding fish control have been two. First, the effectiveness of such control during spring and early summer when aquatic vegetation is relatively less developed. Second, the effectiveness of the aquatic vegetation of summer and early autumn in protecting larvæ against fish. Enormous production of Anopheles was observed in rice fields and in the pools and ditches adjacent to them in spite of an abundance of minnows.

A point worth consideration—a matter which has undoubtedly been well developed by Mr. Hildebrand—is the possibility that the maximum of Anopheles production, and with it, perhaps, the onset of the malarial season, may not be postponed, in some localities at least, by the activity of fish in spring and early summer while aquatic vegetation is sparse.

Mr. Le Prince. Do you care to make any remarks, Mr. Hildebrand?

Mr. Hildebrand. Referring to the places where minnow control apparently failed, I believe this to be largely due to the fact that not enough minnows were present and that the competition for food was not great enough. It isn't always possible to increase the competition, but sometimes it is.

I want to mention an experiment we conducted on a ditch in Savannah. We had quite a heavy mosquito production in that ditch, but we added 7,000 minnows to this comparatively small ditch, which was at the time completely isolated, and within about one week 100 per cent control prevailed.

Mr. **Le Prince**. We have heard the talk along the line of the necessity of county work. Now, there is other work, agricultural drainage work, being done in counties, and where the State health officers are beginning to have sufficient agricultural drainage work done that will lessen the amount of mosquito work you will have to do.

We are fortunate in having with us Mr. McCrory, in charge of that class of work for the Department of Agriculture, who will read a paper.

AGRICULTURAL DRAINAGE AND ITS RELATION TO MALARIA CONTROL.

S. H. McCrory,
Chief, Division of Agricultural Engineering, United States Department of Agriculture.

The wet swamp and overflow lands of the United States have an area of more than 100,000,000 acres. In their present condition these lands are unsuited for agricultural uses and in certain sections of the country constitute a menace to the health of those living nearby. The timber has been cut from most of these lands and in their present condition they return but little income to their owners.

That the drainage of these lands would have a beneficial effect upon the health of those living in many areas in the South is, I believe, generally agreed. Looking at this problem from the viewpoint of the sanitary engineer it is probably desirable that these lands be drained as soon as possible; there are, however, other factors than the public health that enter into the problem. Nearly all the land is in private ownership and the desires of the owners must be considered in any undertaking which affects the condition or use of these lands. The area of land now in cultivation in the United States is probably large enough to grow all the crops that our present population needs. From an economical standpoint an increase in the area of cultivated lands should be made only as our population increases or the demand in the markets of the world increases. An overproduction of foodstuffs is apt to have a disastrous effect on both agricultural and industrial efforts. This year we have grown the largest crops of corn and rice that the country has ever produced and large crops of cotton, wheat, and other staples, yet, despite these splendid crops, our farmers are complaining that they are not prospering.

In the past supply and demand have to a large extent controlled the development of our wet lands and if our farmers are to continue prosperous any plans for the drainage of our wet lands should not bring more lands under development at once than can be utilized without serious overproduction. It is doubtful also if labor is now available to place large areas of newly reclaimed land under cultivation at this time. Many other factors affect the problem of developing our unused lands and it is one that deserves careful study by all interested in order that a sound policy may be developed.

The drainage of our swamp and overflowed lands has been accomplished in the past mainly under the provisions of the State drainage laws. All States having any considerable area of wet lands within their boundaries have passed such laws, and all of the Southern States, with possibly one exception, now have workable drainage laws whose validity has been approved by the State supreme courts. The details of the various laws differ considerably in different States but the main features are substantially the same. In general, the laws are drawn upon the supposition that the proposed improvements must benefit either the public health, the public welfare, or the public convenience. The projects are initiated by petition of the requisite number of landowners to the proper official. On receiving the petition an engineer or board of viewers is appointed who makes a preliminary survey and files a preliminary report upon the project. If the project is to be established, the report must show that the project will benefit either the public health, the public welfare, or the public convenience, and that the benefits resulting from the construction of the proposed improvements will be greater than the cost. The official to whom the report is made upon receipt of the preliminary report, fixes a day for a public hearing and notice is given to all interested landowners in order that they may appear and protest against the establishment of the district if they desire. At this hearing a finding is made for or against the establishment of the district. If the finding is in favor of the district the proper official orders it established, final surveys are then made, bonds sold, contract for the construction let, and the improvements recommended built at the earliest possible date. The cost of the improvements is assessed to the lands benefited, usually according to the benefits received by each parcel of land. Throughout the proceedings the interests of all landowners are carefully protected and they are given opportunity to appeal to the proper authorities for relief from any apparent injustice. Usually the cost of the work is met by issuing drainage bonds, which are later repaid by the collection of the assessments upon the lands in the district. Such bonds bear from 5 to 6 per cent interest and are exempt from all Federal income taxes, which makes them a very desirable investment for persons of large income. This, in brief, is the method followed in organizing and constructing drainage systems.

Under the provisions of such laws about 5,000,000 acres of our wet lands have been included in drainage enterprises in the nine Southeastern States, or approximately 10 per cent of the lands needing drainage in these States. The cost of this work to December 31, 1919, as reported by the Bureau of Census, has been $28,532,545, or an average cost of $5.70 per acre. It should be remembered that not all the land included in these drainage enterprises has been completely reclaimed, and it is probable that by the time the reclamation of the land now included in drainage enterprises is completed, the cost will be at least twice as great, or approximately $11.50 per acre. Much of this work was done before the increase of prices for such work and the cost of future undertakings will be somewhat greater, due partly to the increased cost of the work and partly to the more difficult character of the project. When we realize that the first modern drainage law in the Southeastern States was not passed until 1909, it is apparent that considerable progress has been made in draining our wet lands. In a little more than 10 years approximately 10 per cent of the wet lands in the Southeastern States have been placed under reclamation, or at the rate of 500,000 acres per year. Had it not been for the war, which practically stopped drainage work, the areas would have been much larger.

Experience with these projects has shown that if adequate drainage is to be secured the projects must be carefully planned by competent drainage engineers and that construction work must be properly done. One important lesson that we have learned is that the drains must have sufficient depth, and that they had better be too deep than too shallow. In territory where drainage work is just beginning the tendency is always to make the ditches too shallow. This should be guarded against in all new projects. Under ordinary conditions 8 feet should be considered the minimum permissible depth for mains and submains; 10 feet is better if it can be obtained. A small ditch of proper depth is generally more effective than a ditch of considerably greater capacity that is too shallow. Much information in regard to the design of drainage projects is now available and can be found in the technical journals and in the bulletins of the United States Department of Agriculture and the State agricultural colleges. There are some precautions that, from the standpoint of the sanitary engineer, should be taken on every drainage project. Care should be taken that openings are left in the waste banks at all low-point places and at the points where old watercourses are crossed, and the engineer should insist upon having a good smooth finish to the banks, berms, and bottom of the ditch. Practically all specifications for drainage work provide for this but the specifications are usually not carefully enforced. If openings are not left in the waste bank, water is certain to collect back of them and stand there until it seeps away or is evaporated. Such ponds afford breeding places for mosquitoes. This water is objectionable also from the standpoint of the construction engineer, as it tends to make the waste banks cave, thus obstructing the ditch. A smooth uniform finish is most desirable, especially on streams where the flow is intermittent, as when the work is roughly done water is left standing in the bottom of the ditch in pools after the flow stops. Aside from the benefit to health that may result from the elimination of such pools our investigations have shown that a well-finished dredged ditch will carry at least 10 per cent more water than one poorly finished. Field ditches should be replaced by tile drains as rapidly as possible, as most field ditches now afford a breeding place for mosquitoes; the field ditch is expensive to maintain, occupies a considerable part of the land, and interferes with the use of modern farm machinery. On many farms the cost of keeping the ditches in condition will more than pay the interest on the money required to pay for tiling the land. There is no more effective way of removing water from the land than by tile. Much of the wet land in the coastal plain region responds readily to tile drainage, and as the sandy nature of the soil permits deep drainage and wide spacing it can be drained at a relatively low cost. On most lands the benefit to crops is more than sufficient to warrant tiling, to say nothing about the benefits to health.

Clearing the timbered land after it is drained seems to have a considerable effect upon the health of the community; this is probably due to the fact that when the land is cleared and placed in cultivation the low places are ditched out and the sun and wind reach the soil more readily, causing a higher rate of evaporation.

While much land has been drained and to a large extent utilized in the past 10 years, from the standpoint of the farmer, it is not desirable to drain the land too far in advance of the time when it can be utilized for farming. Some one has to pay interest on the cost of the drainage work and for the depreciation in the drainage ditches after they are constructed. If this is done a considerable time in advance of the time when the land is placed in cultivation, it adds considerably to the cost of the land, generally without any resulting benefit to the farmer, unless it be from benefiting health conditions in the entire community. If this benefit to health is to be made a strong argument for undertaking drainage projects primarily for sanitary reasons, much more educational work will have to be done before it will be supported by the interested farmer. In my judgment, it is very doubtful if in sparsely settled communities the time has yet come when such projects should be undertaken, but in the well-populated regions both economic and health conditions usually warrant large drainage projects. The lands along the small streams of the Piedmont region of the South are typical of such streams. In the coastal plain region of the South if 25 per cent of the lands in a given section are in cultivation and the land is wet, a drainage district will generally be a good investment. I have long thought that more should be done toward the elimination of malaria and the work that you are doing is one in which I have been and am greatly interested. In your efforts to educate the public generally in regard to the benefits resulting from eliminating malaria the facilities of the department for disseminating information might in some instances be used to advantage. The Extension Service, through the county agent, the home economics agents, and the leaders of the boys' and girls' clubs, is able to reach a large part of our rural population, and in this work they are the joint agents of the Department of Agriculture and the State agricultural colleges. The Extension Service is only one of the mediums through which the department reaches the farmer. Other agencies are bulletins, press service, and the services of specialists in various lines of work. The Division of Agricultural Engineering, Bureau of Public Roads, carries on what work the department does in relation to farm water supply and farm home sanitation, and we shall always be glad to assist any of you who may be interested in getting in touch with the proper officers of the department, and so far as our resources permit to cooperate in any way possible. If the American farmer is to be as successful and efficient as he should be, it is essential that he and his family have good health and proper living conditions. We hope that your work will be so successful that there will be a general improvement in the health of the rural population.

DISCUSSION.

Mr. LE PRINCE. Questions are in order. I am going to begin this discussion by asking Mr. McCrory one question which I think we ought to know about. Have you had many applications for assistance from the county health officers or the State departments of health who could benefit largely from the work of your division?

Mr. MCCRORY. We have had a few requests from county health officers and in one or two instances from State departments of health. I believe there is one drainage district in Georgia that was initiated by a request from one of the sanitary engineers in the employment of either the State health department or the Public Health Service.

Mr. STROMQUIST. I would like to ask Mr. McCrory if in establishing drainage districts there is any fund provided for maintaining the drainage canals.

Mr. MCCRORY. Most State drainage laws make some provision for maintenance but usually it is not enforced.

The problem of maintaining our drainage ditches is one of the most serious that confronts engineers engaged in drainage work. There are a few districts in Arkansas and Mississippi, and probably a few in the other States, where they are doing maintenance work, but much more should be done than is now undertaken. Maintenance is desirable from two standpoints; it enhances the efficiency of the drainage district and it benefits the health of the community. We have made investigations on the effect of maintenance on the efficiency of the ditches, and we are convinced that with an annual expenditure of from 1 to 2 per cent of its cost the life of a drainage ditch can be greatly lengthened, and that with regular maintenance work the expenditure required for maintenance will be very much less than if the policy now generally followed—that of digging the ditch and allowing it to deteriorate until it becomes useless and then redredging—is pursued. We made some experiments in Mississippi on the capacity of drainage ditches that had not been maintained and on those that were maintained. Maintenance increased the capacity of the ditches about one-third.

It is interesting to note that many defects in the construction of ditches, such as lack of openings through waste banks, which result in water standing back of waste banks, rough finish, and similar defects which have a bad effect on the life of the ditch are objectionable from a sanitary standpoint, while good work where these objectionable features are eliminated makes for better sanitary. conditions. The work of the drainage engineer and the sanitary engineer is closely related, and it would be to the benefit of the public if there could be a much closer relationship on drainage projects.

Mr. Fuchs. I should like to ask Mr. McCrory to give us a little data, if he has it, on the relative cost of tiling and open ditching, and as to whether the cost of tiling is prohibitive for farmers and property owners in general.

Mr. McCrory. Open ditches for outlet drains will cost from $7.50 per acre up in the coastal plain region of the South and from $30 an acre up in the Piedmont section. These ditches are necessary for outlets for field drains, whether the latter are tile or open ditches. Tiling at the present time costs from $40 an acre up to possibly $100 an acre. One serious difficulty that is confronting men engaged in drainage work at the present time is the difficulty of securing tile. Prices are high—abnormally high. Labor has been scarce, and the cost is getting to a point where the farmers feel that it will not be profitable to install drainage. I think that until there is a material readjustment of the cost of tile and labor and the price of farm products, little tiling will be done. Under normal conditions in the coastal plain regions of the South the increased yield from the tile-drained lands pays a large return on the cost. Small ditches for draining fields will cost less than half as much as it would to tile the land, but such ditches require maintenance, occupy considerable land, and over a period of 15 or 20 years will cost more than it would to tile the land.

Dr. Fricks. I would like to say just one word about cooperation between the engineers engaged in agricultural drainage and the engineers engaged in drainage for health purposes. I had the pleasure of discussing the matter briefly with Mr. McCrory in Atlanta a few days ago. It has always appeared to me that such cooperation is highly desirable. I have also had the pleasure of discussing this matter with the Surgeon General of the Public Health Service, and I find that he is heartily in favor of a program in which the two governmental agencies can cooperate for the improvement of health and living conditions in the South. I trust that the chairman and Mr. McCrory will be able to discuss this matter while they are here together and will be able to prepare a memorandum for the Surgeon General and the authorities in Washington upon which a cooperative program can be based.

Mr. Clarke. I would like to ask Mr. McCrory if there is any satisfactory method of removing willows from ditch banks. I have noticed that where they grow there are potholes, and these potholes—a chain of them through the ditches—dry up; and then, after a rain, form again. Fish control in a case like this is out of the question. As to killing the willows, is there not some solution of poisons, which could be applied to the roots, that would be effective in getting rid of them?

Mr. McCrory. With proper maintenance the willows should not be allowed to become established in the ditch. As effective a way as any of keeping willows down would be to sow the berms and ditch banks with Bermuda grass or some other grass suited to the territory, and then pasture the land. This would keep the willows and other trees down in fairly good shape; or, the willows and other trees can be pulled each year, or if large, cut down. The Forestry Service has a formula that will kill trees of various kinds. In some places it has been used very successfully; in other places with not such good results. The time of application, possibly, has some effect upon the results obtained. I am unable to give you that formula from memory, but it can be secured by writing to the Forestry Service at Washington. With proper maintenance of the ditches no willows or other trees would be allowed to grow on the berms or banks of the ditch.

Mr. Stromquist. It seems to me that cooperation between the county agricultural agents and other agricultural organizations and the health authorities will be very valuable, but at the same time I think that a sharp line of demarcation should be made between the two activities. For instance, if we sanitary engineers went around and told the farmers something about farms, we might give a good deal of misinformation. The same thing might be true of agricultural engineers, who had a very superficial knowledge of health work, attempting to give information about sanitary work.

Mr. Fisher. I should like to ask Mr. McCrory whether there is some provision made by law for maintenance work.

Mr. McCRORY. In most States there is some provision made for maintenance, but usually that feature of the law is honored in the breach rather than in the observance.

Dr. GRIFFITTS. Most of these drainage laws include provision for the protection of the public health, and in their preambles land drainage seems to be secondary to the matter of public health. I should like to ask Mr. McCrory if, in any of the States, after these drainage laws are in operation, the health end of it has not been entirely ignored. You may, in some instances, greatly increase the production of Anopheles and decrease other types in swampy areas by confining the water without current in the deep drainage ditches.

A year or two ago, I went through drainage districts in North Carolina and inspected some of the canals installed four or five years ago. I found Anopheles breeding in canals and conditions favorable for malaria should the locality be populated.

Much of the malaria danger could be obviated by putting a "ditch within a ditch"—or a small ditch in the bottom of the canal. In many cases this would result in lowering the maintenance cost of the canal. I discussed this matter at the National Drainage Congress last year and I remember that Mr. Vaughn, of Wisconsin, said that for years he had finished canals by taking out the last shovelful in the center, and that he had done it solely for the purpose of holding down maintenance cost. I would like to know your opinion about this.

Mr. McCRORY. Some of the drainage ditches that have been constructed in North Carolina, I have felt, were probably of little benefit to health conditions. I have in mind particularly those in Robeson County, which I have followed very closely. The bottoms of the ditches were covered with a dense growth of grass, cat tails and similar vegetation, making an almost ideal breeding place for mosquitoes. We have conducted some experimental maintenance work in that district. We made a small low-water channel in the center of the large ditch, cleared out the vegetation, and cleared the banks and berms. The carrying capacity of the ditches was made as large as when first constructed. The top minnows were given access to the shoreline, and breeding places for mosquitoes were practically eliminated. While we are not able to control the growth entirely, yet with the limited work that we were able to do we improved the conditions very materially in the ditches on which we worked, and we could see the effect of that work two years afterwards when we went back to do more maintenance work.

My experience with drainage ditches has been that their effect on the public health is forgotten after the ditch is constructed. This has always seemed wrong. Careful maintenance of the ditch would be in the interest of better drainage and better health.

In regard to the small ditch in the bottom of the large ditch, it depends almost entirely on your soil. If you have a stiff clay, the small, low-water ditch will work well; but in the sandy lands, such as are found in the Atlantic Coastal Plain region, it is doubtful if such a ditch would last long enough to be of more than temporary benefit.

Mr. LE PRINCE. I wish to call everybody's attention to the fact that Mr. McCrory prepared and read a very interesting article on drainage operations as conducted by his division at the meeting of the American Society of Agricultural Engineers, and those of you who are interested in these drainage matters should get a copy of the proceedings of that society and see the article. We thank you very much, Mr. McCrory. [Applause.]

The next paper on the program is "Organization of malaria control division in State board of health," by Mr. L. M. Fisher.

THE ORGANIZATION OF MALARIA-CONTROL DIVISION IN STATE BOARD OF HEALTH.

L. M. Fisher,
Associate Sanitary Engineer, United States Public Health Service.

If I comprehend the object of the demonstration work in malaria control that has been done during the past few years, it is to induce the doing of more and more and still more malaria-control work until the whole remaining section of the country in which malaria is prevalent shall have been cleaned up. This is going to be a big task and one not lightly to be tackled without definite plans for its accomplishment. Since malaria control is primarily a health measure, it seems logical that malaria-control work should be carried out by health organizations. In addition to the health features of malaria-control work, however, there is the tremendously important economic aspect which makes its appeal strongly to the business man. He sees it as a scientific tool with which to increase profits. The health officer sees it as a means for reducing morbidity statistics and death rates. The business men in the malarious sections have not been slow to see the advantages of malaria-control work derived by neighboring towns where malaria-control work has been carried on. They will look to the existing health agencies for assistance in the work. And the existing health agencies are not at present prepared to undertake it, or even to give adequate assistance.

The argument is sometimes advanced in some quarters that because there are some 37 Federal health agencies doing work they should all be brought under one public health service. This may or may not be good reasoning.

There are always two sides to every question. Should not the fact that there are so many agencies be regarded as an indication of the inefficiency or inadequacy of the organizations that were in the field at the time the newer agencies entered?

I do not believe in the unnecessary multiplication of organizations for accomplishing the same purpose. If the existing organization can be used it should be used. If it does not make itself useful or adapt itself to the accomplishment of the objects the public expects of it, it must expect new organizations to enter the field. And the fact that the present laws give it exclusive jurisdiction will not permanently preserve it from encroachment or curtailment of its field of activities if it fails to perform the service for which it was created. Eventually the presence of two organizations doing the same work will lead to waste and increased inefficiency at the expense of public funds, and the more useful and more aggressive will dominate the field.

It is a delicate problem in adjustments to harmonize and coordinate the aims and policies of two separate organizations engaged even in the same work. The interdepartmental jealousies that are found in so many of the branches of our Government are illustrative of this point. With a multiplication of the number of the organizations the problem is not simplified. It is seldom in life that conditions are as satisfactory as we could wish. We must make the best of the situations with which we are confronted. And often surprisingly satisfactory results can be accomplished. It often happens that the development to which an organization attains is very different from what it would have been had it been possible to plan it at a later date in the light of earlier experience.

The work in which a number of us find ourselves at present is a strange mixture of scientific or quasi-scientific investigation, propaganda work, organization, the administration of philanthropy, and the discharge of some governmental functions. Our fight against malaria seems to be in a state of semiorganization in many places. The division of the Federal Government devoted to scientific investigations has been seized upon and made to direct the fight. This has occurred because to many it appears to be the most logical agency to direct a nation-wide campaign against the disease.

In a certain sense the control of malaria is a local or regional health problem, or at least one that concerns only the State. But in another sense it is a serious national problem because of the fact that it affects such a large portion of the country and perhaps somewhat indirectly the whole country. The Nation and the State are therefore both interested in its solution, and should both be actively engaged in working out the problem; the efforts of the one should supplement those of the other. Because government is slow to appropriate money for expenditures which result in indirect benefits, and because the work of educating the public to appreciate and understand the magnitude of these indirect benefits is a slow process, private philanthropy and commercial and industrial interests find here an attractive field in which to work. Striking results have been attained for sums expended.

For geographical reasons and in order to benefit by the machinery of organization already in existence, the State health department is the logical place in which to set up a division in which the activities can be best coordinated and directed.

From such a division, advice, helpful suggestions, a certain amount of direction and supervision should be supplied to the people of the State. A study should be made of the malaria problem in every community requesting it, regardless of whether a demonstration could be made there. Every farmer should be able to get advice in solving his malaria problem. The more forehanded and intelligent citizens of the State are beginning to demand such a service. Individuals, corporations, and communities are willing to pay the actual cost of the work but desire to know that they are working along the right lines and to receive proper direction and guidance.

The work that has been done as a demonstration is attracting attention and causing new inquiries. As fast as people learn that their State government has taken up the fight against malaria they appeal for advice and assistance. To meet this demand there should be set up in the State board of health a division devoted to this work. So much for the needs of the immediate present. Let us look somewhat into the future if possible.

I believe that sooner or later the Nation will recognize its obligation to assist that portion of the country where malaria is present, not alone out of considerations of philanthropy but because it is good business. When the time comes that such moneys will be available it is conceivable that Congress will stipulate that the supervision of such expenditures be, to a certain degree, at least, in the hands of officers of the Federal Government. It is a comforting thought that our President-elect when in the Senate favored such appropriation and will no doubt continue to do so.

Malaria-control work is largely a question for the engineer. It is not primarily a medical problem by any means. There is a phase of it, namely, quinine prophylaxis, which is medical, but antimosquito methods of control, which are more positive in their results and more frequently used, are almost purely engineering. Medical science is interested in the control of typhoid fever, but the safeguarding of our public water supplies, the construction of sewerage systems and sewage treatment works are engineering problems and have played an extremely important part in the prevention of typhoid fever in our large centers of population. So also the engineer will play a very important part in the prevention of malaria.

Aside from the purely engineering features there are involved problems of organization and administration, problems with which the engineer in his work is frequently confronted. Because of these considerations it is probably advisable to have a competent engineer at the head of the division of malaria control. In fact, in a well-established board of health having a competent engineering organization it might be made a part of the engineering division. But the work is of such importance and the field so specialized that a separate division in the department seems to be desirable.

Because of this the head of the division should report directly to the State health officer. Close touch should be maintained between the head of the division and the State health officer in order that there may be complete harmony in the policies which are to be carried out. The details should of course be left to the executive head of the division, but broad general questions of policy should be worked out with the State health officer.

There is a decided advantage, it appears to me, in having a representative of the Federal health agency as the executive head of the division. This comes in the comparative ease with which he can get several local health agencies to cooperate with each other and with the State in a given undertaking. Take the case in which a county and city organization should cooperate with the State and possibly other agencies in doing a given piece of work. It may be that the city at some time in the past tried to get something out of the State and was not entirely successsful. It will nurse the grudge. In the same way there may be a spirit of jealousy between the city and county and between county and State, or more correctly speaking, between officials of these civil organizations. They are much quicker to lay aside these grievances when approached by a disinterested third party, an agent of the Federal Government, than when one or the other of the three assumes the rôle of mediator.

Organization plays a large part in our daily affairs. Sometimes I dream of the time when large sums will be made available for malaria-control work. Just where this money is to come from is a problem not easily solved. I have a scheme in mind which may be visionary to a degree, yet I can not help but feel that it could be worked out if sufficient energy were employed and enough people interested. Briefly, it consists of quietly raising a good-sized sum to be available over a period of one or two years, say of several hundred thousand dollars by individual subscription, to be used in a campaign of education, to inform the business men of the United States of the money loss they were suffering annually because of malaria in the South, to inform the philanthropically inclined of the tremendous amount of misery and sickness occasioned innocent people because of malaria, and to point out how, by the doing of a certain amount of permanent work, this could be prevented. We give hundreds of millions to the heathen, and to people who spasmodically fly at each other's throats in deadly warfare, and leave our own population to be decimated by preventable diseases.

This campaign of education and propaganda could be carried on by a concern specializing in community leadership or by a league of chambers of commerce and a preliminary organization effected.

Funds could be collected by the American Red Cross or by special commissions, and a nation-wide sentiment built up against the spread of malaria that would induce Congress to make helpful appropriations.

If such a scheme could be worked out the division of malaria control would be one of the connecting links between the money on the one hand and the field work on the other. If nothing along such lines ever develops, it is not unlikely that sooner or later Federal aid will be given and the States that have the nucleus for a well-organized division of malaria control will lead the way in reclaiming some of the most fertile lands in the country and making it habitable for the white race.

In summing up, it is desired to call attention to the following points:

1. The control of malaria is a problem of major importance to State boards of health in the South, and one that is only just beginning to receive the attention that it deserves and which an awakened public will insist that it receive.
2. Because malaria is not a serious problem in some of the more fully developed and richer Northern and Eastern States, where well-organized health agencies exist, we can not use them as models after which to build. We must devise something to meet our requirements.
3. Because of the importance of malaria-control work and because of the magnitude of the problem, and for other reasons, the head of the division should report to the State health officer.
4. Because of the predominance of engineering features, problems of organization and administration, included in the program, a competent man, preferably with engineering experience and training and special training in malaria-control work, should be placed in charge.
5. In order that the State health officer should not be placed in the embarrassing position of receiving a gratuitous service and not feel free to direct, and in order to make it possible to obtain a competent head, the State should contribute to the salary of the director, or at least the director should hold a commission from the State government.

DISCUSSION.

Mr. PARKER: There are 105 counties in Texas in the malaria belt. Tentatively a plan was approved by the State health officer, on my suggestion, of extending the work. I selected a territory to extend from the western border of the malaria region to the Louisiana line. About 50 towns were selected out of that region, all of which I had a clear idea would be able to support the work without outside help.

The plan was that the State health department would maintain a man in the unit that had been under control this year; that the director of that unit would move on to another unit that would be in direct railroad communication with the old unit, so that he might supervise it and the work being carried in the old unit. It was deemed necessary to have more than the usually haphazard statistics on these towns before we went into them to make surveys. So in the 50 towns that were selected for surveys it was suggested that some man be appointed by the State health department to precede the surveys to gather accurate malaria statistics and institute a system of case reports.

Under these conditions the engineer operating in that section has laid plans for expansion by having complete data available on a number of towns scattered over an extensive territory. Preliminary operations of this nature will tend to create an interest in the different sections and greatly simplify work when it is commenced, and most important of all allow work to be done at a lesser expense.

With such a large number of counties requiring malaria-control measures very little could be accomplished in a reasonable time with the extremely small personnel now operating in the State, should county-wide campaigns be conducted. In spotting the work systematically over the State it is believed that the greatest State-wide results can be obtained, as the spirit of the work seems to radiate from any central point where operations are under way, and at a later date the systematic joining of the number of units created could be undertaken.

Dr. Harrison. Mr. Chairman, I should like to say that we in Texas heartily agree with the suggestion of the first speaker; that is, that a division of malaria control should become a part of the State health department, with a man at the head of such a division who could rightly be considered an expert to direct the work.

In regard to the plan that Mr. Parker has suggested, the State health department did tentatively approve that. However, it will be extremely interesting to us to have some further discussion of that plan. I would like to ask Dr. Fricks, and also Mr. Le Prince, to discuss this plan for just a minute or two.

Mr. Le Prince. I call on Dr. Fricks for his opinion.

Dr. Fricks. Mr. Chairman, I don't think I am in a position to discuss this plan very fully at the present time.

We all realize that the cooperating agencies, the Public Health Service and the International Health Board, have not yet been able to decide exactly our financial status for the next year. If that is what Dr. Harrison means by discussing it, if that is the information that he is anxious to get—and I understand very readily how he would like to know—I will say frankly that I am not in a position to give it at the present time. So far as discussing it in a general way, I might do that.

Personally, I can't help but feel that the movement is toward the county health unit and that ultimately it will be the basis of our health work all over the South. I may be wrong about it, but that is my personal opinion. But, on the other hand, we haven't got far enough to determine just exactly the best procedure to be adopted for all States. I am sure we all realize that the same measures which would apply in Texas might not apply in South Carolina. I appreciate very well your distances and sparse population.

It seems to me that it is the duty of the State health authorities to consider this matter carefully and formulate a program for the extension of malaria work. In the work which we are carrying on we are not going to be hidebound, and if the State health officer of Texas, after discussing this matter with Mr. Parker, feels that that is the best plan for Texas, why I am sure that Dr. Harrison and the cooperating agencies will be open to any argument or reasonable conclusion which they may reach.

I should like to say one word in regard to Mr. Fisher's paper, without making any comparisons. I realize that the sanitary engineers worked under different conditions, but I know what Mr. Fisher has done in South Carolina in regard to establishing a malaria division or nucleus for future malaria work in the State health department, and I think it was fine.

Mr. LE PRINCE. I believe that we ought to have a malaria-control division in each one of at least 14 of the Southern States. It is possible that it is a little early yet to have those divisions, but I think in the past a mistake has been made. Our health departments of the South, many of them, are relatively young, and probably there has been too big a tendency to copy the health departments of the States farther north. I am not referring to any one State. Our health problems of the South are different, decidedly different, from what they are in the North, and therefore the arrangements of the budgets for health work in the Southern States I personally feel should be entirely different from what they are in the North. Not only that, but the budget for one State need not necessarily be the same as that for the adjacent State.

I believe you are going along in the right direction at the present time, so as to get the public to see the need of and demand antimalaria work, and when you get them thinking seriously along those lines I don't doubt but that you are going to have State appropriations for the antimalaria work. We ought to have started working for that five years or more ago.

I believe in not letting any work fail if it is possible to keep it up, and I do believe that we can find, in any demonstration area, a good local man who gets his first training as foreman and then the second year, or later, can act in the capacity of supervising foreman, so that the engineer will just have a general supervision and see to it that things can not go far wrong. That will be the means of the engineer doing a lot of work. I don't know whether that was the general scheme Mr. Parker outlined or whether I got off the track.

I have spoken with three men who are working in Texas and they seem to think that the time is ripe for county work. Then it looks as though the time is still more ripe for the organization of a division for malaria control within the State. I do believe, however, that as money seems to be the hard thing to get there ought to be cooperation between the health departments of those Southern States interested in malaria work, so that we can get a very good malaria film that will not only appeal to people, but will make that appeal be heard so that we can be sure of sufficient public support when the State health officials attempt to get the appropriation they need. We haven't got enough backing; we want the backing of the people, who are not going to be denied, and if the proper film is gotten up and used in three or four States in doing county work through the malaria belt, so that everybody knows about malaria, its causes, and the facility with which it can be controlled, I think the demand for the appropriation for the State board of health will be very strong and there will be more of those voted into power who are favorable to public health work.

Mr. STROMQUIST. I think there is no doubt in the mind of any of us that a malaria division in the State board of health in each of the malarial States is necessary and that a sanitary engineer should be in charge of such a division; but I think about the most important factor in the success of an antimalaria campaign is the inspector—an inspector with four qualifications: A pair of strong legs, more than an average amount of common sense, plenty of pep, and an interest in the work. If you have such an inspector your chances are very much increased for putting on a successful campaign. With such an inspector we could supervise more work, and what we need is to train such men for the work. I think it would be a good idea to have them partly under the control of the State board of health and not entirely under local control, so that they could be used in different places and on different kinds of work. Thus you could assure them permanent work all year round.

I think Mr. Magoon's idea of amalgamating a number of city jobs is a very good one, particularly in towns of the size he has been working, in which I understand, there are populations of only eight to ten hundred. A town of that kind can not pay much for a marshal, inspector, and other positions, but if a good man can be found to combine these jobs and in the malaria season devote most of his time to that work the town can afford to pay such a man a living salary and get a good man.

We are hoping in Tennessee to use the balance of the local funds that were appropriated for mosquito work this year to employ a full-time sanitary inspector to work with the city board of health. Members of this board of health haven't got time to go out and make inspections, but if they have a sanitary inspector to work under their direction they can do a good deal of work in improving sanitary conditions of the community.

Mr. Shaw. I think the situation as it is at present is very unsatisfactory to the engineer in the field. Of course, I realize we have been in the formative stage of the work, conducting demonstrations, but it appears to me that we have now reached the point at which it is necessary to organize or formulate some plan whereby the State and municipal organizations will take over the work. We all know that with further extension of the work it will be impossible for the Public Health Service to furnish supervision for every town. The cooperative plan must terminate at some time in a particular community and it will then be necessary for the local officials to take entire charge. The work of encouraging the continuance of malaria control and of advising where necessary will become the duty of the State board of health, for which purpose they should be forming a malaria division.

After the first year's demonstration the town should be prepared to continue the work with only general supervision, first by the Service, but as soon as possible by the State board's representative. But it appears that the tendency of both the municipal and State authorities is to unload on the engineer in charge and not take an active interest in what is being done. This attitude was clearly expressed by the health officer of a certain town. After I explained the general plan of our operations and stated that during the second year we would give general supervision, he said, "I will help you as much as I can." It seems to me that after one year's demonstration the situation is just reversed—the Public Health Service, the International Health Board, and the State board of health will help the town as much as possible.

Dr. Griffitts. Mr. Chairman, things usually appear to me as either black or white. I am a little inclined to be too much that way, and not to see the intermediate colors, but I do think that ultimately the people have got to protect their own health. We are not doing work to-day for the mere purpose of making beautiful charts, or for the number of feet of ditches we put in it at so much per. Our work is building for the future—what effect we can have upon malaria 20 years from now or 25 years from now. Is there a possibility of completely eradicating malaria, or stopping its existence as an economic factor—as a factor that tends to lower the physical manhood of this country, so that, if we are called upon again we won't be faced with a 25 per cent physical deficiency?

Now, we must reach the people. We have said for years that this is a rural problem, and up to this time we have been almost cruel to the rural people—we have neglected them, and they are the sinews of the Government. It seems to me that for the next few months, when we will not be digging ditches, when we will not be chasing the festive Anopheles or the pestiferous Culex, it might be well for the officer in each State to consult with the State health officer and to make a study of each State health organization with a view to deciding on the best way to carry on the next year's work, whether through the county units, through State propaganda, or other methods.

I might state that there are different opinions among State health officers as to how this problem should be met. Some State health officers may take the attitude that it could be worked out better under the supervision of a physician than an engineer. I have heard such expressions.

Others take the attitude that it is better to have it an engineering division. Others will say, "Why not attach it to our rural health work and get it established in our county units as soon as we can?" In some instances the overhead can be cut down greatly by so doing.

If we study these conditions very thoroughly with the State health officers and submit a report to headquarters, I think we can arrive at a very sane conclusion as to what we shall do next year, and what we shall do toward the future control of malaria.

Dr. Harrison. I should like to say that our idea in regard to establishing a malaria division was that the head of the division should have the responsibility of raising the funds for the work. Our idea has been that the engineer is unquestionably the man to carry on the operations, but we have found some of the engineers rather loath to assume the responsibility of raising the money. Therefore, they have suggested in Texas that a doctor connected with the State board of health should go out and make the financial arrangements. We feel that whoever is the head of the division should be the man to assume that responsibility. If the engineer will do that so much the better.

Mr. Le Prince. I would like to make the statement that where possible the engineer ought not to have to do all the financial work; the engineer is there to do engineering work. Now, in the work that is going on on such a large scale in New Jersey and one of the counties in New York, the financial arrangements are all made, and the man who is directing the antimalaria control work does not have to bother to get the money. He is there for another purpose; he is there especially to do a certain class of work, and it is a loss of time for him to have to go into the other work. I think that stand is perfectly correct.

Mr. **Parker**. Mr. Stromquist, I think, brought up one of the most important questions that has come before us in regard to the extension of the work; that is, holding the services of the men we train. It is not necessary that we have a trained engineer, or a trained director as general foreman in a unit that has already been put under control. We can take one of the men who has been trained in one of the several towns under operation. At the present time I have a man who is ready to undertake such work if I can place him on the pay roll of the State board of health or take care of him in some other way for 12 months of the year. His services have been absolutely gratis the whole year. He knows how to proceed and is just the man that we need to leave in charge of such work, and he can take care of the four towns that have been under operation this year.

Mr. **Le Prince**. Mr. Fisher will close the discussion.

Mr. **Fisher**. It seems to me that the present uncertainty of plans for the future justifies any arrangements that will remove the uncertainty and give us something definite with which to work on. I believe that that uncertainty might be to a large extent eliminated. This plan necessarily calls for the expenditure of some money for administrative purposes to be controlled by the malaria-control division. Some of the details which it would have to perform would be to collect statistics and to prepare publicity articles and direct and supervise the use of moving picture films throughout the State, prepare a budget of expenses and take it to the State legislature, and be prepared to defend the items contained therein.

The big problem is to build up a personnel who can be used for this kind of work. I might point out that one weakness of the present arrangement appears to me to be the difficulty of holding trained men. There are certain contingencies arising at headquarters, which we in the field do not know about, and certain considerations make it advisable to send a man into the State who may be the only man available, and he may not like the State; he may not like the particular kind of work, and on that account may not fit in. If a man can be obtained locally and trained into the work it would be by far the best arrangement. We have found it very difficult to find any local man of sufficient intelligence, ability, and interest to undertake the work in any place where we have worked in South Carolina, so that we had to import talent. At one place we were fortunate in securing a man who had a good deal of training in the sanitary corps in the Army, and he is now remaining in the town where he worked as permanent health officer for the city, and to that extent is adding to the personnel, which should become a part of the division.

This is a problem, of course, for the future, and, as has been pointed out, we are just now going through the formative stages, but it certainly behooves us to develop definite ideas and have them clearly in mind as to just how such a division could be effectively organized and as to the details with which the organization will function. It is hard to determine just what they will be and perhaps impossible to standardize them for all States.

Mr. Le Prince. The next paper will be "Railroad malaria work," by Mr. H. W. Van Hovenberg.

RAILROAD MALARIA WORK.

H. W. Van Hovenberg,
Sanitary Engineer, St. Louis Southwestern Railway.

Since so many of the men here are familiar with the malaria work being done by the St. Louis Southwestern Railway Co., I will only sketch our work briefly, inasmuch as a report embracing the past four years is to be published soon by our line.

Malaria control on the Cotton Belt dates from the interest of Mr. Edwin Gould, chairman of the board of directors, in the discovery that about one-third of all the medical treatment in the hospital was due to malaria patients. He enlisted the aid of the Public Health Service, and, following a field survey, actual work, both in the protection of employees and in offering cooperation with cities, was started under the direction of a sanitary engineer employed by the railroad.

The problem of malaria control on a railroad is complicated, due to the fact that its employees are scattered along many miles of line, live under varying conditions, and work both day and night. Many employees live in so-called camp cars that are moved from point to point over the line, as, for instance, bridge and building men. These men spend a large part of their time in the river bottoms, where there is a splendid chance for malaria infection. Trainmen may live in a division point, but spend half of their nights at other points on the line, where they may not have protection from the malaria mosquito. Railroad malaria control, then, is one of applying the remedy best suited to each particular case.

The starting of malaria control in a town is an old problem to you men. The St. Louis Southwestern Railway particularly stressed the cooperative plan of malaria-control work in the cities and towns along its lines.

I would say that in the beginning the railroad supplied practically all the funds for malaria field work. During the past year, however, practically 75 per cent of the cost of the work was supplied by the cities.

Following a study of the hospital records as to which departments of the railroad supplied the most malaria, it seemed practical to begin our work in our large-shop towns. This made it possible to protect a large number of employees and to furnish the same protection to their families. The protection of men living in camp cars was effected through screening of their cars and teaching them the value of swatting mosquitoes in cars.

In order that we might demonstrate the economical side of malaria control to the management, we cooperated with several large lumber mills. In one instance we demonstrated that the mill production could be increased 20 per cent in one year, leading to a material increase in the freight revenue from this one mill alone.

We have used all practical methods of malaria control known to us, including a demonstration as to the practicability of quinine in prophylactic doses. During the past year we issued quinine rations to section men over 360 miles of main line. The result of this demonstration will be published soon.

Through the Public Health Service we have established a full-time technician in our employees' hospital, greatly increasing the efficiency of the hospital as well as aiding materially in sterilizing men who have been employed for years on the railroad and who could have been giving but a small part of their energy because of chronic malaria infection.

The St. Louis Southwestern Railway management saw fit to equip an exhibit or demonstration car for the purpose of teaching malaria control directly to the men employed over the system. This car was also used in stimulating the interest of school children in Texas and Arkansas. Our plan was, briefly, to enter a town and to get in touch with the principal or mayor and arrange to have the school dismissed so that one class at a time could visit the car. A talk was made to the children in language they could understand, stressing the part that each one of them could play in mosquito abatement. We asked the teachers to examine the children on what they had heard and seen. On return visits to several of these towns we found the children to have been very receptive.

Rather than offer financial aid to the cities in Arkansas as we have done in Texas, I thought it best to spend the same amount of money in educating school children. We hope that when they become business men and women in these towns they will be more than willing to establish malaria control and adopt other essential sanitary measures.

The result of four years of malaria work on the Cotton Belt has been to enlarge the work of the sanitary engineer to include all phases of health protection. A full-time organization was found imperative to carry on malaria control work successfully. This led to the adoption of a sanitary-control program which includes malaria control, water supply, station sanitation, heating and ventilation, quarantine, camp-car sanitation, station grounds beautification, etc.

I predict that in a few years sanitary engineers will be employed by all modern railroads. Our railroad managers will find that it will pay better to keep employees on the job rather than to pay for their hospital treatment. For such work as I have just outlined a sanitary engineer is eminently fitted.

I would like to stress the value of knowing the number of malaria prescriptions in relation to estimating the prevalence of malaria in a community. Mr. George Parker has demonstrated that an estimate of the amount of malaria, based on a study of the doctor's prescriptions, will check within 1 or 2 per cent with the actual cases of malaria. Another evidence of the general prevalence of malaria is the amount of newspaper advertising carried by chill tonic manufacturers. These people necessarily know just how much malaria there is in a community by following the sales of chill tonics, and their advertising will keep pace with the amount of business they do.

I believe it is important to know the amount of malaria in a town compared to other diseases. The number of malaria cases alone does not mean much to the average person when his support of malaria campaigns is solicited. He is interested though when you say, "Ninety per cent of all the medical prescriptions in this town are for malaria." He knows then that the enormous bills paid for medical and doctors' services are due to malaria alone, and that is a very strong talking point.

DISCUSSION.

Dr. **FRICKS**. We should all feel proud of Mr. Van Hovenberg's work in malaria control, because it is good and because he is one of us. I know he is still one of us in heart. I have been very much impressed with his work, and we have begun malaria surveys on other roads in the South with the hope that we might accomplish approximately as much on these roads as Mr. Van Hovenberg has on the Cotton Belt. We are now making malaria surveys on two roads, the Central of Georgia and the Illinois Central; and, Mr. Chairman, we have here as a guest Dr. Beach of the Illinois Central road, whom we should be pleased to hear.

Dr. **BEACH**. I have listened to the excellent paper presented on "Railroad malarial work" with greatest interest and pleasure. The railroad which I have the honor to be with, the Illinois Central, has, with the cooperation and assistance of the United States Public Health Service, undertaken a survey over the portion of the system in which malaria prevails, and will consider the employment of active remedial measures which may be recommended as a result of this survey.

I desire to earnestly recommend to those interested the necessity of getting in touch with a first-class publicity man, one whose newspaper experience and ability as a writer will enable him to present the absolute necessity of cooperative antimalaria work to the public—let the public understand what we are trying to do, not by one write-up, but by a series of write-ups appearing in various papers which circulate through the country in which work is being done. This feature of the campaign I consider a great necessity, for until the public is in close touch and entire sympathy with the movement, money for necessary expense will be slow in coming.

With the splendid success accomplished by Mr. Van Hovenberg, of the Cotton Belt Railroad, there should arise the spirit of emulation among all railroads, and it is greatly desired that the next year will see the furtherance of this work until malaria becomes only a memory.

Mr. LE PRINCE. The next paper on the program is "Publicity," by Mr. E. H. Gage.

PUBLICITY.

E. H. GAGE,
Sanitary Engineer, International Health Board.

Publicity is the act of making a thing known to the "plain people of the land." As applied to malaria control it involves making known the cause of the disease, its prevention, and cure. The mere act of placing a quantity of information in such places that it is available to the people is probably theoretical publicity, but it is not effective publicity. To be effective the publicity given any subject must be presented in such a way that it is noticed, assimilated, digested, and made a part of the everyday knowledge of the people. In order to get effective publicity the person in charge of the campaign must know the people whom he has to reach. That is, in my opinion, the first step in any publicity campaign. No two communities have the same local problems or interests, no two can do effective malaria control by identical measures, and also no two can be reached by identical publicity. Once the people have been studied, their problems analyzed, and their interests learned, a method of publicity may be worked out founded on their interests, as the mind is more open and easily approached from that angle, and applied to their individual problem in such a way as to make them feel that it is their own campaign.

Originality in publicity is very much sought after. The most frequent result of the search is the production of some entirely meaningless thing, striking in itself, but of no value in advertising the subject matter. Let the same amount of originality be exerted first in studying the people to be reached, learning their point of view; then in finding and presenting in usable form, the connection between this and malaria control; and there results original publicity material which will demand attention. It is the same idea as finding a man's hobby and then riding it with him and selling your line from that angle. For instance, a golf club in Virginia did about $2,000 worth of excellent Anopheles control work after being approached from the standpoint of the mosquito nuisance on the course and at the club house.

Starting with the assumption that the people know nothing of the cause of the disease, and in most cases this is true, give them the whole story in terms that they can easily understand, in frequent bits, only a little at a time so that each part may be thoroughly understood. A common error in publicity is the use of too much material at one time. The human mind can only take in and digest so much at a time and to go beyond that limit is to practically defeat the aim of the advertisement. Frequently—because it is not a subject which commands intense interest from its first mention—there is too long a history of similar conditions lived through and too strong a conviction of the inevitableness of chills in swampy regions for that. Give them something which they see is actually connected with their own everyday life and then there is a foundation for some real work, effective work, in malaria control.

It is better to tell something which the people already know as a starter than to give the reader something which his previous information does not lead him easily to understand. As an instance, I was riding on a train one day with Dr. Griffitts and listening to his talk with a fellow traveler, who, I knew, occupied a position of some merit in his community. The conversation turned to mosquitoes and presently the man asked, "What sort of an insect lays mosquitoes, anyhow?" It required considerable explanation to convince him that mosquitoes themselves lay the eggs from which other mosquitoes develop, as he was thoroughly under the impression that they were laid by a bigger insect, such as a dragon fly. Now, if the publicity campaign in that man's town had been complete he should have known the life cycle of a mosquito. Instead, while he knew that malaria work was being done in town, it was only in a general way that he knew it. A good publicity campaign would have told him, a little at a time, what was being done and what he could do to help. The idea of giving the people something to do to help is one of the best methods known to stimulate interest.

Effective publicity is, in fact, the preparation, the stimulation, and the history of malaria control in any community, and to fulfill its mission it must be based on the habits and interests of that community. It must teach the people that malaria is not a necessary evil in their community and that the spring and fall "course of medicine" is not an absolute requirement for health; how mosquitoes breed, and eliminate the idea so strongly held that mosquitoes breed in pea vines and similar places; that malaria is transmitted only by the mosquito and is not caused by bathing in the middle of the day, although an attack may be brought on in that way, provided the infection already exists; and finally it must bring the individual to the place where he knows, believes, and practices such control measures as are possible on his own premises, for if he does not he is sure to have mosquitoes all summer, will more than likely be unwilling to admit that the work has been of any value, and is certain to oppose any appropriation for maintenance.

This can only be brought about by a study of the special problems in any particular community, followed by a constant application of local conditions to the work of malaria control, and underlaid by a real personal interest in the welfare of the community.

DISCUSSION.

Mr. LE PRINCE. I have felt that in Texas the work developed very rapidly and that the influence of considerable publicity that has been carried on there for several years can be noticed over a good section of that State, and I believe a considerable portion of that publicity has been done by Mr. Van Hovenberg. I am going to call on him and ask him to give us a few pointers regarding publicity. A lot of us have to prepare articles for publication, and if we can get a skeleton of useful information in preparing our data for the papers I think it will be worth while.

Mr. VAN HOVENBERG. My answer would be to distribute widely Dr. Carter's Catechism. This pamphlet entitled, "Malaria, Its Cause and Prevention," is known as Supplement No. 18 to the Public Health Reports, July 17, 1914. This bulletin may be partly rewritten or issued to newspapers in the form as it is now. Newspapers will be glad to carry this matter daily or weekly. The next medium that I would suggest is the semiweekly farm newspapers or farmers' magazines. The editors of such publications are always looking for scientific material of interest to their readers. If possible, furnish articles to the newspaper men, together with pictures illustrating the contents of the article. These pictures need not be gotten up in as elaborate form as we find in the Sunday supplements, but may be just a column wide. These cuts cost little to have made and can be reproduced from photographs we now have. I believe Mr. Parker has developed one of the most unique ways of advertising malaria control that I know of. This consists of asking the daily newspapers to include with paid advertisements a brief sentence as follows: "Mosquitoes breed in water." "I believe in malaria control," etc.

Mr. Parker can tell you more fully about his methods and I will ask him to take the floor.

Mr. PARKER. It occurred to me that it was much better to advertise in short sentences some facts about mosquitoes and malaria rather than put lengthy articles in the papers. When they read the first few lines they decide they know all about mosquitoes and quit. I took the matter up with the merchants of one town who carried advertisements in the paper, and requested them to instruct the newspaper to insert in their advertisement such short sentences as, "Mosquitoes breed in water"; "Mosquitoes are the hosts through which chills and fever are transmitted"; "Mosquitoes breed in water only"; "Get rid of mosquitoes"; "We believe in fighting malaria; do you?" Just one line was used at the bottom of each "ad," because most of the country papers are devoted a great deal to advertising and the people were sure to read them.

Something of three lines can be written, little squibs regarding mosquitoes or malaria, and scattered in different parts of the paper. The short sentence, "Cut your weeds," appearing throughout the paper, started a program of weed cutting in the town, and in a very short time a great many people were cutting weeds.

Dr. FRICKS. I don't want you to think I am throwing cold water on any legitimate program for advertising malaria control, but I want to remind you that in our original cooperative agreement for malaria control there is a paragraph in regard to publicity coming through the State health officer. I am in favor of publicity, I want you to get it in every legitimate way you can, but the Public Health Service is handicapped in this respect and can not enter into an extensive campaign of publicity, and we have entered into an agreement with the cooperative agencies as to the method of publicity.

Mr. LE PRINCE. As I understand, outside advertising that met with the approval of the State board of health would be satisfactory?

Dr. FRICKS. Absolutely.

Dr. HARRISON. I should like to state, speaking for the State board of health of Texas, that it did unquestionably meet with the approval of the State board of health.

Mr. OLD. At Thomasville we had some little handbills made up, such as this, and had them distributed in the houses.

I had a little experience with moving-picture houses in three towns worked in Georgia. I got up little slides on malaria and they ran them for about a week and then stopped. Sometimes they would only leave them on for half a second and you couldn't read them at all; presumably because they weren't paid for it. I wonder if any others present had any experience along that line.

Mr. SHAW. It appears to me that publicity in our work has two phases; the preliminary publicity for educational purposes and to arouse the people's interest in malaria control generally, and the publicity during operations to secure cooperation and to advise the people of the progress and results accomplished. I think it is a mistake for the engineer to enter a town where no publicity has been conducted, for the people in general are not familiar with the facts concerning malaria, and are not aware of the plan of conducting the malaria demonstrations.

Generally speaking engineers are not inclined to publicity work and they are probably as deficient in this as they are notably deficient in public speaking. For this reason all publicity, press articles, and papers for educational work, so far as possible, should be centralized in the State board of health or one of the other cooperating agencies, and prepared in such a way as would make them suitable for the entire South. Let the preliminary publicity and papers for educational work include articles on "The history of malaria investigation," "Malaria, its cause and effect," "Habits of mosquitoes," "Malaria control demonstrations prior to the World War," "Army cantonment control and the results," and "Demonstrations since the World War." The preliminary publicity should be accomplished in advance of the initial survey and thus pave the way for the field engineer.

Since the State boards take the initiative in arranging for demonstrations and the demonstrations must ultimately be conducted by them, this publicity should be issued from their offices.

Mr. Fuchs. Mr. Chairman, I would like to mention a scheme of publicity which may not bring immediate results, just as Mr. Van Hovenberg's educational campaign among children may not, but which will eventually bring results when these children have grown up to be citizens.

What I have in mind is an educational campaign in the form of a contest carried on by the North Carolina Land Owners' Association. They obtained through the Surgeon General and the State board of health about 30,000 copies of Dr. Carter's Catechism on Malaria; they distributed them all over the eastern section of North Carolina, where malaria exists, among the children in the schools. Contests were carried on in each school, in each town, in each county, and then in the State as a whole. The children were asked to submit essays on the subject of malaria after they had become acquainted with the catechism, with the aid of the teacher, and these essays were judged locally. The best ones were sent on to be judged by the county officials; the best of these in turn were sent on to a committee, among which was the State health officer, for the State contest. Local prizes, as well as State prizes, were offered.

Now, what was the effect of these contests? They not only brought the study of malaria control to the attention of the children, but each child in writing a composition on malaria, took it home and talked about it with daddy and mother, and everybody in the family was discussing the question. As I say, we have, perhaps, not seen immediate results from this campaign, but I have no doubt that its fruits will ripen with time.

Mr. Parker. Mr. Chairman, I want to bring up the school proposition again because of a request that came to the State board of health from the principal of a school in a rural community. He advised us not to go down there because if we did the people would be so antagonized we couldn't get anywhere; that he wanted some literature so that he could educate the children and the people in that community regarding malaria control.

I want to mention Mr. Van Hovenberg's exhibit car. In the town of Alto they had taken up the study of malaria, using Dr. Carter's handbook, in their science class. Mr. Van Hovenberg's car was in that town and the exhibit was shown in the schoolhouse. There was a great deal of enthusiasm demonstrated by the different pupils, and a great many questions asked. I found out later they had been advised that on their examination papers would appear certain questions pertaining to the work that was being done in their town to control malaria; that they would be required to write certain articles pertaining to mosquitoes, their life cycle, and so on.

Mr. JOHNSON. In two of the towns in Alabama the school children from the fourth to the seventh grade studied the malaria primer and were given examinations on it at the end of the year. I looked over the papers together with the principal and I was very greatly surprised to see how much they absorbed. As a matter of fact, they had seen some points in that primer that I hadn't.

In one of those towns they didn't hire any oiler or any inspector during the season. The school principal drew a line through the middle part of the town and they had one group of school children doing the oiling and inspecting on one side of the town and another on the other side, and they had a prize for the group that did the best work. I spent two days in the town and couldn't find a larva or mosquito there.

My experience with movie slides has been very satisfactory. The theater manager in one of my towns was greatly interested in the work and showed the slides at the most advantageous time.

We were greatly bothered at one time by a tremendous rush of Culex. There were more tin cans in Demopolis than I ever saw in my life. It was perfectly obvious they were coming from those tin cans. We hardly knew how to get the people in the town interested. I talked the matter over with a newspaper man and a movie man and they suggested that we just run a lead in the movies in good, big letters, " Punch the can." We showed that slide in the theater about a quarter of 9, and at 9 o'clock the next morning we had about a hundred boys lined up in front waiting for their punches. If they didn't get all the cans, I don't know where they were; I couldn't find any that were not riddled.

Mr. LE PRINCE. There will be no further discussion. I am going to call this meeting adjourned until 1 minute of 8 to-morrow morning. We expect a full attendance.

There will be another meeting to-night at the Architects' Club. A moving picture on mosquito control is to be shown, and you will find it a most interesting one. Also a paper on mosquito control will be read at this evening's meeting. I suppose you have all seen the program. I think it starts at 8 o'clock. The Architects and Engineers' Club of this city have invited us to come and I think we ought to show up 100 per cent strong in courtesy to them. They have loaned us this room, and I am sure we all appreciate it. You will show whether you do or not by your presence this evening.

Evening Session, November 16, 1920.

Members of the Antimalaria Conference met with the Engineers and Architects' Club of Louisville at 8 p. m. in the rooms of the Club.

In addition to other transactions, a paper on "Engineers and malaria control" was read by Mr. W. G. Stromquist. The paper was followed by a moving picture film entitled "Bit by Amos Quito."

ENGINEERS AND MALARIA CONTROL.

W. G. Stromquist,
Associate Sanitary Engineer, United States Public Health Service.

From the ancient days of the doctor with his leeches and mysterious herbs, all health work has been considered as being solely within the province of the medical profession. This was a natural consequence of the lack of regard for development of sanitation, and because medical science was limited to the curing of human ills. It is only in recent years that preventive medicine and sanitation have become highly developed. To-day we know that there are many diseases which can be controlled, and greater effort is expended than ever before to keep people well, instead of waiting to cure them after they become sick.

The engineer has played an important part in this work, far more so than is generally recognized. Water purification and sewage disposal, which have been effective in greatly reducing the death rates from typhoid fever, have been developed and recognized by the engineers as their problems. The rôle of the engineer in the control of yellow fever and malaria is not so well known.

The first yellow-fever-control work was begun by Col. Gorgas in Habana in March, 1901. After the campaign was well organized the antimalaria work was begun. Col. Gorgas's right-hand man in direct charge of control work at Habana and later in Panama was an engineer, Mr. J. A. Le Prince.

When the work was undertaken in Habana, it had been proven that a certain mosquito, *Aedes calopus*, was the only transmitting agent of yellow fever, and that the Anopheline mosquitoes carried malaria. The habits of the mosquitoes were not known, and when it was proposed to control these diseases by mosquito eradication the idea was ridiculed on all sides. The courage of these men in attempting the work without precedent or previous experience, in the face of innumerable obstacles, and the effective manner in which the campaigns were conducted, are worthy of our greatest admiration.

The engineer on this work had presented to him a variety of problems such as the habits and characteristics of the mosquitoes in regard to their breeding, resting places, flight, food, etc.; methods of control of their breeding places by drainage, oiling, larvicides, use of natural enemies of the mosquito; the protection against mosquitoes by screening and the destruction of adult mosquitoes. Coincident with wrestling with these problems it was necessary to develop and direct an organization for conducting the campaign. Immediate results were demanded and had to be produced while the methods were being developed. This required engineering ability of the highest order. Without it the Panama Canal would not be in operation to-day.

The first malaria-control work attempted in the United States was at Fayetteville, N. C., in 1913, as a result of recommendations made by Asst. Surg. Gen. H. R. Carter, of the Public Health Service. During the winter of 1913–14 the Roanoke Mills at Roanoke Rapids, N. C., started work for mosquito eradication to protect their employees from malaria. Similar work was begun at Electric Mills, Miss., in 1914, and also by the Pittsburg Plate Glass Co. at Crystal City, Mo. This was the pioneer work in the United States and was conducted under the supervision of the Public Health Service.

To study methods of malaria control, their relative values and costs, the Arkansas State Board of Health, International Health Board, and Public Health Service in 1916 inaugurated demonstrations at Crossett and Lake Village, Ark., which have been continued and extended to other communities in that State.

Investigations were made at different places to determine the effect of impounded waters upon the prevalence of malaria in the adjacent territory.

In 1916 two engineers, Charles Saville and H. W. Van Hovenberg, conducted an antimalaria campaign at Dallas, Tex., which proved so successful that the work has been given a permanent place in the activities of the city health department.

But considering the great need for malaria control and the vast field open for it, comparatively little was done during the period of 1913 to 1917. However, a small group of earnest workers were laying the foundation, accumulating data, and gaining experience, which in a crisis proved to be of inestimable value. In this work an engineer had an important part.

The crisis came when we entered the great war and many of our training camps and war industries were located in malarious regions. Thousands of men from places free from malaria were placed with infected men, where numerous Anopheline mosquitoes were present to spread the infection. The results would have been disastrous without malaria control, immediate, effective, and on a big scale. The work was done mainly by engineers, to most of whom it was a new problem; yet they accomplished splendid results.

In the cantonments the control measures were directed by the Sanitary Corps; in the extra-cantonment areas—the civilian territory surrounding the training camps—and at various war industries, by the Public Health Service cooperating with the State and local health authorities. The total area controlled under the supervision of the Public Health Service was more than 1,200 square miles.

The results of this work are indicated in the report of the Surgeon General of the Army, when he states that among a total of 3½ million men there were 14,000 cases of malaria, with 31 deaths. Had the same rate prevailed as in the Spanish-American War there would have been 1,900,000 cases and 5,600 deaths. Records are not available to show the effect among the civilian population affected, but statements of physicians practicing in these areas indicate reductions of from 75 to 95 per cent.

During the past year the International Health Board and the Public Health Service, cooperating with the boards of health of 11 States, have conducted a series of demonstrations of malaria control by mosquito eradication. One or more units of two to four towns have been established in each of the 11 States, with a sanitary engineer in charge of each unit. Very satisfactory results have been obtained as regards the control of the malaria-carrying mosquitoes. Complete data to show the reduction in malaria are not yet at hand, but there is no doubt that a very marked reduction has been effected in all the communities where the work was done. The cost has averaged 74 cents per capita and $1.26 per acre. This is very reasonable and economically feasible when it has been shown that some sections of the South pay an annual malaria tax of over $12 per acre in doctor bills, loss of wages and crops, etc. In one of the demonstration areas reports from less than one-half of the families of the community showed that in 1919 malaria had cost these families $3,300 in doctor bills, medicine, and loss of wages. The cost of the antimalaria campaign in 1920 was $1,800. The comfort of being practically free from the mosquito pest has been an important factor in making the work popular with the public. The ultimate purpose of these demonstrations is the development of State and local health organizations to direct and extend the work.

Malaria is being recognized as a business proposition. Since 1917 the St. Louis Southwestern Railroad has employed a sanitary engineer to direct antimalaria work among its employees and in towns along its lines. The results have been reduced sickness and increased efficiency of employees and greater production in the tributary industries, with more revenue for the railroad. One lumber mill showed an increase of 20 per cent in its production as a result of the first season's work, which added $60,000 to the railroad's freight revenue. The officials of the road have been so favorably impressed that the work has been expanded and other sanitary work included, so that all-year positions can be offered and a permanent organization be maintained under the direction of an engineer.

This paper is not an attempt at a history of malaria control, but an outline of its development has been given to indicate the part played by the engineer.

Malaria control offers splendid opportunities for the engineer. The problems of drainage, oiling, and other methods of mosquito control are his problems. There is yet much to be learned, and a need for development of more economical methods. Malaria control is needed over a territory of 400,000 square miles, with a population of over 10,000,000. The problem presents economical, social, and educational features. Its solution will require careful planning and efficient organization. The need for effective and economical work, the opportunities for great service to humanity are such as to appeal to the highest instincts of an engineer.

Malaria presents a problem not only to the sanitary engineer directly concerned with its control, but also to every engineer and architect in a malarious community. Most directly it affects the health of himself and his family. An engineer on a railroad survey party, a drainage or water-power development project, a mill superintendent, or a man in any branch of engineering in the South is constantly confronted with the question of malaria control. He must produce maximum results at a minimum cost. Efficiency and malaria can not exist together. The engineer must realize that he has been responsible for an increase in malaria in many localities—what Dr. Carter calls "man-made" malaria. Undrained borrow pits on railroads and highways, culverts placed too high so that a pool forms on the upper side of the embankment, impounding reservoirs—all of these afford ideal breeding places for Anopheles, and in many places have caused an increase in this scourge of the South.

Malaria is the greatest problem of the South to-day. It causes an annual loss which has been estimated at more than a billion dollars and human suffering which can not be estimated. A child infected with malaria can not get the physical and mental development which is its right. From such we can not expect the highest type of citizenship. A man who has malaria is at times only one-half a man or no man at all. A community where malaria is prevalent can not be progressive and prosperous.

The South has vast resources which are yet untouched. The greatest retarding influence is malaria, which must be eliminated before these resources can be fully developed. The engineer must lead in the fight.

Morning Session, November 17, 1920.

The conference was called to order at 8 o'clock by Mr. Le Prince.

Mr. Le Prince. The first paper on the program this morning is "Transportation," by J. C. Carter.

TRANSPORTATION.

J. C. CARTER,

Assistant Sanitary Engineer, United States Public Health Service.

Transportation is one of the items of expense in connection with an antimalaria campaign, and is a subject which deserves much consideration.

As transportation costs are influenced by a wide range of conditions it is impracticable to erect definite detailed policies which will be applicable in each community; therefore the suggestions in this paper are general and are to be taken as such.

In discussing this subject two distinct items must be considered: First, transportation of the engineer or supervising officer; secondly, transportation of labor, materials, etc.

The former assumes greater proportions, as the traveling expense of the engineer continues throughout the year, while that of labor and materials exists only during the time of actual operations.

It has been my experience that during the time of actual operations a light automobile can be used by the field director to great advantage, provided the communities are situated within short distances of one another. Road conditions must also be taken into consideration.

One great advantage of travel by automobile is the elimination of delays caused by waiting for trains and train connections. This is especially important where an inexperienced local foreman or inspector is supervising the work, as is often the case. Here is an instance of time saving by the use of an automobile. Two towns in which I directed campaigns during the past season were 60 miles apart and were not directly connected by rail. The trip from the one to the other could be made in an automobile in about two and one-half hours' running time, whereas the trip by rail consumed one-half a working day with a night en route and its attendant expense.

The engineer will also find the automobile an advantage in covering the area under control within the various communities under his direction. This saves much time and insures an intelligent and efficient supervision.

An automobile for the use of the engineer may possibly be obtained from the State board of health, the United States Public Health Service, or by the engineer buying his own car, in which case the health agencies should pay the running expenses and a reasonable amount each month for depreciation.

During the time of making surveys the engineer as a rule is not so pressed for time that the waiting on train connections will be a serious handicap. Also in many sections of the malaria country the roads in the winter are very poor and at times impassible. Travel by automobile under these conditions is always expensive and uncomfortable, which makes travel by rail at this season of the year preferable.

The transportation of labor and materials is not so great a problem. The municipalities usually have motor-driven or animal-drawn vehicles which can be secured at intervals without the expenditure of malaria funds. Public-spirited citizens also may at times donate the use of trucks or wagons.

The oil company from which the oil is bought will deliver it in barrel lots to designated places within the oiler's zone from which he can work his entire area. Small two-wheeled pushcarts may be used to advantage by the oiler to transport oil from distributing stations to the area under his control.

Railroads will frequently haul materials from one station to another without charge. Motor cars may also be secured from them, but the area which they will serve is naturally limited.

Transportation of labor may be reduced or eliminated by providing a place for the storing of tools and equipment at or near the point of operations and instructing the men to report there at work time, rather than have them meet at some other location, gather their tools, and be transported to work.

DISCUSSION.

Mr. LE PRINCE. Most of those who are here know that according to Government regulations, probably adopted before the automobile came into existence, we are allowed to pay for transportation anything up to $10 a day. We haven't the money to pay for a machine. We can not hire a machine by the month or by the season, and some very definite conclusions ought to be arrived at, this morning, and possibly some representations made to the State boards of health so that they can make arrangements with the localities selected. That should be done before the places where we are to work next year are agreed upon. We must have transportation. We would like some remarks and suggestions for improving the present conditions.

Mr. JOHNSON. I had an experience somewhat like Mr. Carter's, in the same State but in another section. I had two towns 18 miles apart by road, with a pretty fair road between them, not more than an hour by road. If I went by train I was forced to go away back to another point, stay there all night, and get out the next morning, and not only had to lose that day but had to run a hundred miles by railroad. There is not just one place like that in Alabama; there are dozens of them. I think that we can not get anything that will help out malaria work in Alabama more than adequate transportation by automobile. Like Mr. Carter, I don't know where it is coming from, but it has got to come from somewhere if we are going to handle that work successfully.

In making preliminary surveys I have found that you can get local transportation. I had one county in which I made 10 surveys about two weeks ago. All the car fare expense was from Montgomery to the county and back. In every town I went into I got a local physician interested and got him to take me all over the whole town in his automobile and drive me on to the next town.

Mr. Le Prince. I want to ask, Mr. Johnson, whether you were given transportation during the malaria season.

Mr. Johnson. I wasn't given much transportation during the working season. When you go into a town on one visit on a preliminary survey you can almost always get an automobile, but when you go back often during the working season the physician isn't going to take you around; he hasn't got the time.

Mr. Le Prince. I want to hear from some one here who has actually got transportation during the working season.

Mr. Davis. The city authorities in Savannah, Ga., before we started work there, agreed to furnish transportation, which they did from the time of my going there until the end of the season, at the expense of the city alone.

Mr. Le Prince. Has anybody working in several units been able to have a car from one unit to the other during the summer time?

Mr. Ropes. I have had some success in Malvern in getting free transportation. The inspector we had was connected with the waterworks and he took me around in his Ford car, the cost of which was paid by the city. In some of the other towns I think Mr. Hastings had an arrangement with one of his inspectors by which he got the use of an automobile at a nominal cost. I have also had some success, like Mr. Johnson, in getting some physician to carry me around, sometimes in the town itself, or sometimes from town to town.

Mr. Le Prince. I have been in Mr. Hardenburg's district in Texas, and I found that all the train connections were between 2 and 4 in the morning—perfectly delightful. I went without sleep to make those connections. Now, he made his arrangements with the four towns, I believe, in such manner that each one of the towns paid for one-quarter of the total automobile bill for the season. That is a point which the State board of health should take up and should make arrangements along those lines. If it could be done in Texas it may be done at other places, but I don't think we should operate in units where we have not proper transportation.

I think the average field director would accomplish 50 per cent more work if he had proper transportation.

Mr. KOMP. Just to show what a difference transportation may make in the results of a mosquito campaign; in one of my towns I had a service car that I managed to get from Gulfport, for which the town provided the entire upkeep. In the other town I had no means of transportation. In the first town we had no mosquitoes; in the second we did. I think my experience is typical, and answers the problem right there.

Mr. PARKER. In my unit, for two or three months I was without any transportation whatsoever except the railroad. The trains run so that if I want to get into a town it means that I have to spend all day in that town, even if I only had an hour's work to do. That was true in all the towns. My unit averaged about 8 miles in length. The roads were fairly good and jitneys could be used to go between towns, which cost on an average about $5 to $7 a trip. On a bad day, or if the weather threatened, you couldn't get any transportation. I soon realized that if transportation other than the railroad wasn't obtained in that unit the work wasn't going to be a success, so I bought a car.

There has been an appreciable reduction in malaria, and the only reason I can give for this, outside of the cooperation of the people, is the fact that I provided myself with an automobile. It was particularly necessary to have quick transportation toward the end of the season, when I was having a great deal of trouble keeping labor. This meant that I had to be in two towns during the same day, and especially on Saturday, which was pay day. If I didn't get into those towns, I lost my labor. It took two days by railroad to do what I could do in three hours with an automobile, and I don't think under those conditions the transportation could be curtailed.

Mr. WOODFALL. Mr. Chairman, I was in the Public Health Service for two years, and I fought for this thing from the time I entered to the time I left the service, and finally concluded by walking over 50 per cent of the time. At present I am with the State board of health in Georgia and I still have to walk. During my work on malaria I had to walk from one town to another and look mournfully at every automobile that passed me, hoping that I might be asked to ride, but I found it never worked.

Mr. Old was in a small town in southern Georgia and had to wait about six hours for a train to return to his headquarters. Rather than wait he walked the 11 miles, and he told me that 18 or 20 cars passed him and none invited him to ride. We attribute this fact, however, to his looking more like a hobo than an engineer.

I doubt very much whether the State board of health of Georgia in the year 1921 will have much more money for carrying on malaria work than they have to-day. It is at this time as never before that the southern health departments need the cooperation and help of the United States Public Health Service and the International Health Board.

I realize the need of transportation for the service engineers on malaria work, but under conditions of to-day it is impossible for the Georgia State board of health to furnish men in the field with automobile transportation. We hope that this may be corrected in the future and that some provision may be made whereby transportation may be furnished these engineers.

Mr. Le Prince. In connection with this work of malaria control the press should be considered, and possibly some of the State health departments, by interesting other persons, can bring this matter to the public attention so that we can get a proper sentiment built up. You may not have read the Mississippi statistics of malaria. Those of you who have not done so should, and from the State health officer of Mississippi you can get some very useful working figures. Now, there is transportation for malaria, but it is from the town to the cemetery and back. That is the only fixed transportation that I know of. That transportation involves in that one State 1,000 deaths every year, largely of little children, and if we make these facts known it will help us in this fight. You know there are several hundred cases of malaria to a death, and I want to see that transportation changed from the hearse to the Ford for the engineer.

Mr. Van Hovenberg. Mr. Chairman, I believe we are all here of one mind on the question of transportation. I take issue with Mr. Parker privately on some of the things he said about Texas, but I believe that we all feel that it should be incumbent on the State health department to provide transportation for the man in the field. I move that this sentiment be expressed by resolution as follows:

> That this body of sanitary engineers and others engaged in malaria work in the field go on record as asking the State health departments to provide transportation, as they see best, in the various States in which they are engaged.

Mr. Le Prince. You have heard the motion, gentlemen. Is there any second to that?

Dr. Barber. Seconded.

Mr. Stromquist. Let me interrupt a minute. I would like to add to that, with Mr. Van Hovenberg's approval, "We think that it is extremely important for their success in carrying on the work."

Mr. Le Prince. You have heard the motion. All in favor of that will please rise. The motion is carried unanimously. In this connection, I wish to refer to the remarks made by Mr. DeMott, who has eight machines—it is a case of one man not only handling a county, but handling a county in a most satisfactory way. But he tells us that the automobile is the answer of one man handling a big territory. How can we get the State board of health, and the county with the help of the State board of health, to get the money for it?

Mr. Fuchs. In this connection I want to suggest a plan that was proposed by the State health officer of North Carolina when this matter came to a head. He suggests that after the cooperating towns are selected, the cost of buying and maintaining the automobile be apportioned in the same proportion as the funds appropriated for malaria work—by the various towns, the State board of health, and the International Health Board. At the end of the season the automobile would be sold, if the work is not to be continued, and the proceeds returned to the donors in the same proportion. I think that would be the best solution of it, without being a hardship on any one agency. The International Health Board and the State board of health are interested in this work, as well as the towns, and such apportionment of the cost would seem to be the fairest and least burdensome.

Mr. De Mott. I will explain how we procured machines for Nassau County. After I was appointed chief engineer I read through the files of the time lost by the men, due to lack of transportation, during the years 1916 and 1917. It amounted to about $2,500. I presented these facts to the commissioners and told them the county was paying for the men to work, but we did not have proper transportation to put them on the job. The amount of money that the county lost through lack of transportation would pay for three or four automobiles. Immediately the commissioners decided to purchase four automobiles.

Mr. Le Prince. Is Dr. Fricks here? I might just summarize what has been stated. It has been resolved here unanimously that arrangements be made by the State health departments to supply automobile transportation in order to double the efficiency of the engineers.

Dr. Fricks. What is expected of me, Mr. Le Prince, may I ask?

Mr. Le Prince. We want you to help us, Doctor, and we want your approval; we thought the resolution was not unanimous without it. And it was also suggested in the general discussion that towns be not accepted unless there was suitable transportation provided, in order that the engineers should not do a 50 per cent job, when it was possible to do a 100 per cent job.

Dr. Fricks. We all know that this problem of transportation is one of the most difficult ones encountered in carrying on field work, that if we had adequate transportation in the field, the work would be decreased perhaps 50 per cent in some instances. Certainly 20 per cent is a conservative estimate.

We all know, too, that as far as the Public Health Service is concerned, the matter of transportation is an extremely difficult one to handle. The International Health Board—I am speaking now from a cooperative standpoint—can handle the question of transportation somewhat better, and has in several instances, done so in this work. It seems to be practically impossible for the Public Health Service to furnish adequate transportation for field officers engaged in malaria control investigations under present conditions—the limited size of our allotment and the governmental requirements covering transportation.

What the States can do in relieving this situation, I do not know. I think the resolution submitted is good and hope that it will accomplish something. I have felt that in making preliminary surveys, there ought not to be any need for a field officer incurring expenses for transportation, because the Rotary Club, the city council, or the health officer would be glad to take him around for one day; but I know also that he might easily overstay his welcome, and if he prolonged his visit for a few days and wanted the use of an automobile to make a thorough survey of the town or to supervise the work, it would perhaps be asking too much.

It seems to me that our fundamental idea of tying up with a permanent live local health organization will have a favorable bearing on the matter of transportation. In those towns that are undertaking the work, which have a full-time county or city health officer, transportation will be more easily secured than elsewhere. This seems to me a very excellent reason why communities which have permanent health organizations should be given favorable consideration in selecting a place to work.

Mr. Le Prince. Our next paper will be "Oiling and larvicides," by Mr. E. B. Johnson.

OILING AND LARVICIDES.

E. B. Johnson,
Sanitary Engineer, International Health Board.

In discussing the various factors of malaria-control work, we should not pass the subject of oiling and larvicides over lightly. The mosquito is very sagacious; no matter how well we drain off swamps and ponds, and no matter how well we use top minnows, the mosquito is sometimes able to find places in which to breed, and in which we can prevent breeding and production only by the use of oil or some other larvicide. Many people seem to think that drainage is all that is necessary; in many places I have seen marshes which were drained as well as possible, but which at certain times during the breeding season would produce millions of mosquitoes if oil were not resorted to.

If we consider the costs of a demonstration project for the first year, we find that oil and its application cost quite a respectable percentage of the total; while if we take subsequent years, it is probable that considerably more than half the total cost would be on these two items. Such being the case, it is of the greatest importance to know what larvicides to use and how to use them most efficiently and economically.

Just a little while ago, we were content to mix crude oil and kerosene in certain definite proportions, and blindly spray about everything in sight with it, using it in a knapsack spray, or letting it run out of the nose of a drip can, which usually either wasted a lot of oil or did not drip at all. I think that in the last few years we have made progress in the use of various larvicides effectively and economically, and I want to discuss briefly a few of the methods. Before doing this, I want to make the point that not every body of water should be oiled; we all know that for some reason or other, there are many places which mosquitoes do not use, which appear good breeding places. It is not economical to oil such places unless mosquitoes do start to use them; it is the evil itself we are trying to prevent, not the appearance of it. I believe that we should never oil a body of water until we have evidence that mosquitoes are actually breeding in it.

Under certain conditions an effective means of applying oil to streams and ponds in connection with mosquito-control work, is to use oil-soaked sawdust and waste.

Sawdust used should be of the sawmill variety and not from hard or green wood; these will give trouble by not absorbing the oil properly. The sawdust should be soaked in a mixture of equal parts of kerosene and crude oil for a period of at least 24 hours before being used. Enough sawdust should be added so that when soaked the sawdust will be of a light-brown color, and will separate cleanly and completely when scattered or sown on slowly running water. If too much sawdust is added, the color will be blackish, and the sawdust will remain in clumps when sown, thereby decreasing the efficiency of the oiling. Just enough sawdust should be added to reach this desired result and no more. The exact amount will be easily determined by trial and experience.

Common waste should be soaked in masses or balls about the size of a baseball, in the same mixture as the sawdust. It should, however, be soaked 48 hours, as it absorbs the oil somewhat more slowly than the sawdust does.

To oil large streams, where the water is over 6 inches deep or 18 inches wide, or where the flow is rapid, sawdust is well adapted. At the upper end of the ditch or stream, scatter or sow a handful of the sawdust on the surface of the water, and repeat at intervals of about a quarter mile. In case there is any large pool or lagoon to one side of the ditch in between, a boom, 2 inches above the water line to 2 inches below it, and extending half way from the edge of the stream immediately below the lagoon to the middle of the stream and pointing slightly up stream, will force a little of the sawdust into the lagoon, thus insuring the oiling of the latter.

To oil small seepage ditches, where the flow is neither large nor rapid, use the oil-soaked waste. At the upper end of the ditch pin one of the balls of waste securely to the bottom of the ditch with a stick or peg, having the waste entirely below the surface of the water if possible. One hundred feet down the ditch place a boom entirely across the ditch so that its upper edge is 2 inches above the flow line and its lower edge 2 inches below, and immediately below place another ball of waste in the same manner as the first. Repeat three times at the same interval; this will oil the stream sufficiently for about a half mile, after which interval the entire process should be repeated.

To oil pools or ponds, two methods are recommended, in both of which both sawdust and waste are used. According to the first of these methods, oil-soaked sawdust is sowed on the water around the edges of the pond, and a ball of oil-soaked waste is pinned to the bottom at each of the four sides of the pond. This process has to be repeated every week. According to the second method, a 3-quart flour, salt, or sugar sack is filled with a mixture of oil-soaked sawdust and waste, and the bag then immersed in the oil mixture, and soaked for 24 hours more. It is then moored in the center of the pond by a stone and rope, the rope being long enough to enable the bag to float, but not long enough to enable it to float far away from the center of the pond.

Of these two methods the first is a safer and surer method, but it takes much more oil and time, and is therefore much more expensive. The second method gave at Montgomery, Ala., a film of oil on a pond of a quarter acre for upward of 11 weeks, but is not as safe or reliable as the first method. In very muddy waters it appears to be unreliable, but in clear waters, even with considerable vegetation, it appears to be almost perfect. Choice between these two methods must depend upon the amount of money available and local conditions. Where the second method can be used it should be given decided preference, but it should not be attempted everywhere or under all conditions; it is not capable of universal application, but in its field is the most effective and economical method I know about.

Oil-soaked sawdust used in this manner appears to be especially effective, particularly in running water. The sawdust in passing down the stream works into all the little eddies and side pockets and sticks to every stick, blade of grass, or the like, where the larvæ are most likely to be. Every particle of the sawdust forms a source of oil and gives off a film of oil for from 20 to 50 hours, and since it gets where the larvæ are most liable to be, gives off this film right where it is most effective.

On the other hand, oil-soaked waste appears to be more effective in the sluggish, slow-running seepage ditches and in ponds. The two must be used each in its proper place, but the writer believes that when so used they constitute by far the most effective and economical method of oiling we have.

In the malaria-control work at Demopolis, Shelby, Gantts Quarry, Marion Junction, Mignon, Riderwood, and Green Pond, all Alabama towns, the oiling this year has been done entirely by this method, drip and spray cans having been entirely dispensed with. The results have shown that this method is far more effective and economical than the old methods.

During the past year the use of oil drained from the crank cases of automobiles has come into prominence. As far as I know, the main work on this has been done in Tennessee and in Alabama, and to some extent in other States.

In Tennessee the method was to obtain the oil, strain it, mix it with a certain amount of kerosene, and use it in the spray can. To me this method has several bad features. In the first place it takes a considerable time, and time costs money. In the second place, it is open to all the objections that we have to the use of the spray can.

In Alabama we used a somewhat different method and a much simpler one. We simply obtained the oil and proceeded to soak sawdust in it, just as already described in the case of a mixture of crude oil and kerosene without straining or treating it in any way. We have been unable to find any material difference between sawdust soaked in this way and that soaked with the regulation mixture. The method is then open to all the advantages of the oil-soaked sawdust method and consumes far less time than the Tennessee method.

The cost of this oil varies considerably. In large towns we were forced to pay as high as 10 cents a gallon, while in small towns the garages invariably donated it free. In any case, it was always far less than the cost of the regular mixture.

We also tried to get garages to empty this oil in small branches flowing past their property, but used in this way it was not successful. It clung together in big clots, and would not spread. I think the amount of carbon in it causes this, and that when soaked with sawdust, the oil soaks into the sawdust and thus becomes separated from the carbon; this is the only explanation I can find why it is so successful when used with sawdust, and utterly unsuccessful when used without. This would explain also why when used in a spray can it was found necessary to strain it and mix it with kerosene.

In places where this can be used, it is a very cheap method of obtaining oil, and its use should not be overlooked.

During the war the use of commercial creosote as a larvicide was seriously considered, and a series of experiments carried out principally at Montgomery, Ala., showed that under certain conditions creosote was a very valuable larvicide. Early this year we did considerable work with a compound known as "Kreso" Dip No. 1. This compound was cheaper than creosote, did not burn as severely when spilled or sprayed so as to come in contact with flesh, and was obtainable in practically every little village, whereas creosote was in many localities very difficult to obtain.

Most of the points brought out about the use of creosote at the 1919 conference of engineers engaged in malaria control apply to the use of this dip. It must be used in a small, hand-spray pump, so that the dip comes out in the form of a very fine mist; the finer the mist the better the larvicide seems to work. We used undiluted dip in such a pump, and obtained great success. The dip has several advantages over oil. It evidently poisons, and does not depend on the action of forming a film. It is therefore effective in places where vegetation is so thick that oil would be useless.

At Demopolis, Ala., we had a small stream which was filled with small stones. The larvæ would cling to the underside of these stones, and oil would not affect them. When the stream was sprayed with dip, they came to the surface in droves, and soon floated off down the stream, dead. We used the dip on several places such as this, with the greatest of success after oil had proved to be without effect.

The dip is also very useful in locating breeding. It is often difficult to detect the larvæ, particularly if there are sticks, vegetation or stones to which they can cling. In a surprisingly large number of places at Demopolis we were unable to find larvæ after a long search. Immediately upon the addition of a little of this dip, they would appear in large numbers. They were evidently clinging to the débris, and the formation of a film did not bother them, while the poisoning of the water with the dip brought swift results.

While I do not advocate the wholesale use of dip as a substitute for oil, I believe that its use in places such as those described, and in temporary pools which form about every house during a rainy spell, and which often last a sufficiently long time to be used as breeding places, is important. A prolific source of complaint is Culex mosquitoes which come from the effluents from private sewers. These places usually are not affected by oil, but if a half pint of the dip is rinsed down the sewer once a week, this nuisance will be stopped.

Altogether, it should be said that "Kreso" Dip No. 1 is not a substitute for oil, but that it is a very useful adjunct, and that it is most valuable for use in small places, such as those mentioned, where oil is not very effective.

In conclusion I wish to point out the great importance of oiling in rural operations. In Alabama, and I suspect in most States, malaria is essentially a rural problem, and the cost to the individual farmer is such that often oiling is about the only work he can do, and certainly in most cases it is of the greatest importance. I have been working lately on an oil trap, trying to design a method for catching and using again all the oil used on a flowing stream or ditch. I have attained quite a degree of success, but have not yet developed the thing sufficiently to warrant a report. It seems to me that what we need in oiling now is development along those lines of making oiling cheaper for the rural districts.

DISCUSSION.

Mr. FUCHS. Mr. Chairman, I should like to ask Mr. Johnson whether in broad-casting sawdust he has made any observations as to the effect of the sawdust on the breeding of Anopheles after the oil has evaporated. We have all noticed that a collection of fine floating débris in water, especially in still water, usually is a fine hiding place for Anopheles larvæ. The question is, Does this sawdust, after it becomes free of all oil, act in the same way?

Mr. JOHNSON. I haven't been able to make any observations on that matter this year, because by the time any amount of sawdust accumulated on the water sufficient to do anything of that sort, there was a little rain, which washed it all downstream.

Mr. VAN HOVENBERG (acting as chairman). I would suggest that Mr. Johnson answer the questions that are raised at one time.

Dr. GRIFFITTS. I would like to ask Mr. Johnson three questions. Do you know the kind of mosquitoes that were developed from the larvæ that were hanging below the surface under the rock; next, the cost of the hog dip that was used; and, third, the toxic effect of certain oils that you have used in your work?

Mr. MAGOON. I wish to ask if it is possible to reuse the waste; and if so, what is the method of salvaging it? Was the reclaimed oil found capable of killing larvæ?

Mr. KOMP. I would like to ask how the sawdust was transported, that is, whether there is any difference in the cost of transporting oil in spray cans, and the cost of the transportation of the sawdust.

Mr. JOHNSON. I will take up that last point first, because I think it is very important. I said I didn't use any spray can this year. At Montgomery, during the war, I took over the work for the last time in the spring of 1919. The previous fall they had been using 4 oiling crews of 3 men each—12 men and 4 wagons. I covered the same territory in the spring with 2 crews of 3 men each and 1 wagon. I find that if a man works intelligently, as I believe we ought to teach him to do, he can go out with a 7-quart pail full of sawdust, and that will supply him for at least half a day; while the average oiler with a knapsack spray, which is very heavy, is going to empty it out as soon as he can to get it light. Sometime last September I was wandering around the quarry in a town we were working, and the owner of the quarry came over to me and said, "You fellows get my goat. I wish you had been here last year. We went around here and sprayed everything; we had the oil flowing down these streams a foot deep. We used 150 gallons of oil a week. Now, you come along with a little sawdust and put it in the streams and I don't see a mosquito."

Now, taking up Dr. Griffitts's point, those mosquitoes were mostly Culex. We did find some Anopheles.

In Alabama you can talk malaria control until you are sick and tired and the people are not going to listen to you, but as soon as you say mosquito control they are going to sit up and take notice. There is very little sentiment, I am sorry to say, for malaria control; what they want is to get rid of the pest. Malaria control wouldn't have got the support of the people, simply because what they want is to get rid of the mosquitoes and not malaria.

We found a great difference in the cost of the hog dip. I should say the average cost was about $1.30 to $1.35 per gallon. In some towns we were able to get it as low as $1.25, and in one town it cost $4.25.

I didn't experiment much with other oils because I was well satisfied with what we had.

In regard to the waste, we did try to reclaim some. We found that the labor of going around and picking it up and spreading it out to dry cost more than the waste did. In most cases we were able to get the waste donated by some concerns in town without cost to us, so we dropped the idea of reclaiming the waste altogether.

In regard to the reclaimed oil, I haven't been able to work the traps long enough to answer. There is some difference in the oil, but just how much I am not able to say. I know it can be used effectively over again because I have done it, but I know there is some change in the value—just how much I am not prepared to say.

Mr. **Parker**. Just one or two points. Unfortunately I didn't hear the first part of the paper. The first is how much saving in oiling costs can one obtain by the use of an inspector—in other words, what is the balance between the inspector and the cost of oiling? We know we can save a good deal of oil by not spraying it on places where mosquitoes are not present.

And the second point is whether a small amount of oil will retard or will prevent breeding, an amount so small that it is not necessarily destructive of larvæ.

Mr. **Johnson**. I think that first point is very well brought up. This year I have had my inspectors also do the oiling as much as possible. I have been able to do that this year because the towns I have worked have been small; the largest town I worked has a population of about 3,000, and the inspector was able to do his inspection work and his oiling in about six days. I was able to get an intelligent inspector, and it would have cost me more to have used the shotgun method. I don't think there is any standard method cheaper than all others; I think every man has got to determine that for himself under his own conditions.

Mr. **Van Hovenberg**. We had this one experience in streams filled up with sawdust: In one of the streams leading from the mill pond we found Anopheles persistently. Standing on the bank you wouldn't know there was any water. Just under the surface you would find Anopheles breeding all through the summer. That would be a case where fish control wouldn't do at all.

Mr. Parker has also had some experience in the use of the oil-soaked mop. I would like to hear from him.

Mr. **Parker**. Mr. Chairman, we used the oil-soaked mop where we could not conveniently operate with a spray, on account of the water being confined to a number of crab holes which were breeding mosquitoes. It was found better to take a piece of oil-soaked burlap and dip it in the hole. In the oiling of streams and ponds I found that you could get a better film of oil, and your oil goes farther, by using a large mop and swishing it back and forth as you go along than you will get if you pump the oil out in a spray. However, recently we used spray pumps, because you can get over the work quicker and get better results where you have inefficient labor.

I really prefer the oil mop to the pump, if the place to be oiled can be reached with a stick. You can extend the stick, or handle, several feet in length, but it can be made so long that it becomes cumbersome and can not be conveniently handled.

For several years I haven't used any oil-soaked waste because I don't like it. It has been my experience in the past in using waste that it gives off probably 10 per cent of the oil the first day, and, particularly if it happens to rain or the waste gets wet, a hard crust forms and it ceases to function—no oil gets down over any specified area. If the crust is broken, probably 80 or 90 per cent of the oil is inside of it.

Mr. JOHNSON. I would just like to say this: That I will guarantee that you can take a piece of waste and pin it down, and you go along with an oil can and spray the same amount of stream, and you will find you are going to take twice as much time.

Mr. LE PRINCE. In regard to the discussion of this oiling work, I want to hear expressions from everybody we can. We don't want one person to speak several times. We want to get through with our program.

Mr. O'NEILL. I might add a little to that point Mr. Parker brought up about oil-soaked mops. I used that method about 11 or 12 years ago in a place where I thought that treatment was the treatment indicated. It was on a stream the banks of which were planted with bushes, rushes, and other plants, where ducks were placed, and where the stream was stocked with goldfish and other fish. Spraying oil was out of the question because it would kill the plants, and oiling by sawdust wouldn't do because of the effect upon the ducks and the fish, so the best thing we could see to use was this mop. The worker would carry a pail in one hand and a mop in the other; he would dip the mop in his pail, give it a twist of his wrist, and do about 15 yards with one treatment and get a pretty good film in among the rushes and grasses, where the current wouldn't have carried the oil and where the fish couldn't get in and give you fish control. Up close to the bank where the grass was thick this can be used with success in places where you have intermittent breeding pools and fields which are grass-grown and where to get effective oiling by spraying would be too expensive.

Mr. HILDEBRAND. I want to mention this matter of using oil and fish in the same place. An oil film will not kill fish, but it has a tendency to drive them away. In other words, it destroys food for fish, and extreme precaution must be exercised in using oil and fish in the same place.

Mr. Van Hovenberg. Mr. Chairman, while Mr. Tarbett was in charge of malaria control at Little Rock during the war, he purchased his oil in a railroad tank car from a refinery that gave him just the mixture he needed. I think the State health departments might profit through Mr. Tarbett's experience.

A malaria inspector can easily carry a small syringe with him and on finding dense breeding of mosquitoes can relieve the nuisance by the application of Kreso carried in a small bottle along with the syringe. We know that Kreso and other coal-tar disinfectants have an affinity for water, and that a 5 per cent mixture of such a disinfectant with oil will help materially in spreading the oil over the surface of water. A mixture of Kreso will permit using a heavier grade of crude oil with kerosene oil, with a saving in the amount of kerosene oil required.

Dr. Fricks. Mr. Chairman, it occurred to me that if you had some permanent container for the oil that you may need from year to year you could buy your oil in bulk from a tank car much cheaper than you can in barrel lots. That brings us back to the question of permanent organization again. I do think it would probably be well for the men in the field to consider the possibilities of the erection of permanent oil tanks. Dr. L. L. Williams, jr., had a concrete tank constructed at Park Field, near Millington, Tenn. Of course, under war conditions, it was expensive. But I do think you men who are in the field should consider the possibilities of having permanent containers for oil provided in each community.

Mr. Le Prince. I want to call your attention to a well-written report, published at Little Rock, regarding Mr. Tarbett's work. We have it at Memphis. I think all State health departments and sanitary engineers should have a copy.

Mr. Old. I wonder whether anybody here used kerosene this year. I used it in one town because it was the cheapest oil I could get. The last time I tried to get crude oil they wanted 27½ cents f. o. b. Charleston, S. C. It would cost about 35 cents by the time we got it to south Georgia.

Mr. Le Prince. Somebody could probably give the name of the bulletin issued in California regarding the effectiveness of the lighter oil as compared with the heavy oils in the actual killing of mosquitoes.

Mr. Van Hovenberg. The bulletin was "The Effect of Petroleum Oils on Mosquitoes," by Prof. S. F. Freeborn, Berkeley, Calif.

Mr. Parker. Mr. Chairman, I want to make a suggestion that I think would be in order. I had no ready way of getting oil for one of my towns, but one of the branches of the Southern Pacific Railroad passed through this town. Fuel oil is used for the engines on this road. I took the matter up with the local men and they were unable to do anything, but, as in other matters, it always seemed best to go to the top, so I wrote to the vice president and general manager of the road, and he readily consented to let me have all the oil I wanted at cost price, plus a very small surcharge for transportaion, at the same time expressing his appreciation of the work we were doing and his willingness to cooperate.

Mr. DE MOTT. With reference to spray oiling, previous to the year 1919, we always had an early spring brood of mosquitoes on the north shore. During the year 1919, I had the men oil every violation from Great Neck to Cold Spring Harbor, a distance of 17 miles, regardless of whether breeding was going on or not. We used 1,300 gallons of oil, then watched for results. The *sylvestris* did not appear on the wing, showing that the spring oiling had accomplished results.

In 1920 we oiled all violations in the county, north shore and south shore, with the result that no *sylvestris* (swamp mosquitoes) appeared on the wing during the entire season. What was the result of that spring oiling to the people of the county? We have had people tell us that they thought the mosquitoes must be slow in developing as they didn't get any until about the 25th of June. It has also made the people begin to realize that we are doing some good.

Mr. VAN HOVENBERG. The engineers here will be interested in knowing that there is a grade of oil used by railroads intermediate between crude oil and kerosene, called headlight oil. This oil is cheaper and works practically as well as coal oil.

Mr. SHAW. The use of automobile crank-case washings as a larvicide has been spoken of, and I should think it would be of value to relate an experience and to point out a method of collecting this waste. The service-station manager of a large oil company in Dallas, from which we purchased "mosquito oil," offered my department of the Dallas Health Administration all this refuse without cost. Experiment proved that a very satisfactory larvicide was produced by a 50-50 mixture with kerosene, and upon learning that approximately 300 gallons could be secured from eight stations monthly during the winter, and many times that amount during warm weather, plans were made to collect this material. This manager placed one of the company's 50-gallon faucet tanks at each service station, and our field man would make monthly collections therefrom. For the purpose of collection and subsequent storage the department purchased wooden barrels, which were entirely satisfactory, due to the thickness of the waste. This collection could be extended to garages and all service stations, but it is likely that in some cases the department would have to furnish the containers, which could be collected when filled and replaced by an empty one, thus saving the work of transferring for storage.

Another source of waste oil was the sedimentation in local supply tanks at the large market distributing plant of the oil companies. This waste is a thick viscous material which the companies are glad to give away, and experiments show that a satisfactory larvicide was secured from a 50-50 mixture with kerosene.

Mr. Le Prince. Mr. Gage, I would like to have you tell us how you got along without sawdust when you needed sawdust and couldn't get it?

Mr. Gage. The question of oiling a large area, a pond which was heavily overgrown by aquatic grass, came up. No sawdust was available, but there was plenty of beach sand. The suggestion was made by Dr. Griffitts that the sand might be substituted for sawdust. This was tried with very good results. We were using at that time "summer lubricating" oil mixed with kerosene. We found that the best mixture for the broad-casting of sand soaked in oil was half kerosene and half black oil. This was mixed with sand in a proportion of 30 parts of sand to 1 part of oil, by volume, well mixed either with a stick or by hand. The mixture was simply broadcast over the water from a boat. The sand, of course, immediately settled and apparently each grain liberated all its oil film at one time. We got, in that way, a very good result rather rapidly.

Mr. Le Prince. I want to state, from what I saw of that work, that there was a very thin film, but a sufficient film produced and the work done exceedingly rapidly.

Mr. Lenert. Oil in Louisiana was very expensive, it being necessary to buy it in drum lots, and kerosene was used with a small amount of black oil for coloring matter. The town of Bastrop used gas for fuel and at one time tried to use the waste lubricating oil the second time. This was found not to be economical, and this waste or slop oil was thrown away. During the campaign over half the cost of the oil was saved by saving this slop oil, using 50 per cent kerosene in order to prevent it gathering in large patches on the surface of the water. I think that is one reason that automobile washings usually separate fairly well, they are usually composed of 50 per cent or more of kerosene.

In Monroe the drippings from the engine of one of the sawmills were used for oiling the fire barrels.

Mr. Hardenburg's unit in Texas is traversed by two oil-burning railroads. They have large storage tanks in two of the towns and a sufficient amount of heavy oil is secured at no cost by dipping the waste oil from these vats.

Mr. Le Prince. After we have left Louisville, when the discussion in print comes back to you for correction, some important points may, in the meantime, have occurred to you, and it would be perfectly proper to insert them as part of the discussion. The idea of this meeting is for each one of us to get all the information we can and also impart as much as possible to others.

I desire to discuss a few phases of this oil question. The Chief Entomologist, Department of Agriculture, Dr. L. O. Howard, suggested this matter of oiling in the eighties. It is now 1920 and we have made but little improvement in oiling. When are we going to change? It is high time that we got up some more economical and better substitute for oil. There is one very good indication that we are going to depart from oiling. I refer to the use of fish proposed by Dr. H. H. Howard.

The question of larvicide has been touched upon. I might call attention to the fact that if you get down in the southern countries beyond our border, frequently you will find places where the cactus may be used as a larvicide. Some of the varieties of cactus are good as a larvicide. Also when you get into the brackish waters where the mangrove grows you will find that the tannin in the bark is an effective agent for killing mosquitoes. Simply slice the bark off the tree with a machete and throw it in the stagnant water. That bark will take care of the mosquitoes. We must have a cheaper larvicide than oil. The question of water cress was mentioned. I have seen some of the most perfect breeding of Anopheles in water cress. In the vicinity of Habana, Cuba, the situation was so serious that we had to stop all Chinese gardeners from growing water cress in the suburban sections of that city. It is very interesting that we should have certain sections where the Anopheles will not come into the water cress. That matter should be studied in further detail.

In the construction of the Panama Canal there were a lot of apparently good breeding places in the canal cut where Anopheles didn't appear. An analysis of the water showed the reasons why they didn't come in. Be on the lookout for places where Anopheles ought to be and are not, and don't forget about it. The minute you find it go into the thing. Dig down. Let's get the information we need.

Regarding the matter of oiling by inspectors, I want to warn you very strongly about the necessity of training your foremen into doing thorough work. I find pond after pond and stream after stream where you could examine your shore line and your vegetation very carefully for a stretch of 50 to 100 feet and find absolutely nothing in the way of mosquito larvæ, and in the next 50 feet you would find prolific breeding conditions similar to those in a rice field.

This intermittent production, this series of negative and positive areas in a potential breeding place, is of vast importance, and unless your foreman is on the lookout for that sort of thing he will make an inspection and say to himself, "There is no breeding here," and you will have a serious source of breeding frequently from such a partially inspected area. I ran across just such a condition in Mexico; a large area, for 100 yards no breeding at all, and a couple of hundred yards farther on the most perfect breeding. I have seen it in many parts of this country.

Regarding this question of substitutes for oil; if, in your areas under control, you have an epidemic among your stock, and your cattle dying off, if there is anybody that objects to mosquito control, it is quite possible that they will attribute it to the application of larvicide, and I would anticipate that in making your arrangements. Be careful when you have to apply anything that might be construed as being a poison. I have been in court on that question of the possibility of phenol content, or creosote content of oil.

The remark has been made that the application of creosote to crude oil is beneficial. There is no doubt about that; it will make a thick oil thin and give it four or five or six times the spread it will ordinarily have. You may find it will destroy the rubber pipes you have connected with the sprayer.

Mr. **Stromquist**. We had a proposition in Memphis where we had to consider Culex control to a great extent. We have there the largest cotton warehouse in the world and this cotton warehouse has about 2,000 fire barrels. They didn't want to put oil in the barrels, and we used niter cake with fair results.

We also used what is sold as "sheep dip." It is practically the same kind of larvicide that was used in Panama, and it gave very good results. This, of course, has to be renewed from time to time, but we found that 1 gallon of it would treat over a hundred barrels, so the cost was very small.

Mr. **Foster**. I want to ask Mr. Hildebrand whether he has never found mosquito breeding where there was duck weed.

Mr. **Hildebrand**. I have never found mosquito production where a pond is completely covered with duck weed. I don't know whether or not this observation was made by others. I think that this is in part due to the fact that the weeds cover the water to an extent that the mosquitoes probably can not deposit or hatch out the eggs, the tops of the weeds being entirely above the surface of the water, thus covering it completely.

Mr. **Fuchs**. I wish to call attention to the fact that where there are gas plants in towns very often certain by-products can be found which will serve as larvicides. At Goldsboro, N. C., there is what they call a pressure gas plant. The gas is washed in a tank under pressure and the wash water absorbs a good deal of the oil from the gas. This water was being thrown away, and we collected it in barrels, separated the oil from the water, and used it very effectively as a larvicide by mixing it with kerosene. We found that in the streams into which this waste was discharged there was absolutely no breeding for some distance downstream. We got it absolutely free of cost, and in any quantity we desired. However, it was poisonous to fish as well as to larvæ, and we could not use it where we depended on fish control.

Mr. Le Prince. I would like to ask Mr. Davis whether he has found any other plants that act as a deterrent to mosquito propagation.

Mr. Davis. I don't think that I would care to make a statement in regard to plants at the present time. We have reason to believe, however, that there are possibly some plants that might be a deterrent. I have never found mosquito larvæ in or around duck weed.

The smart weed in dense growths has practically the same effect. In a sparse growth of smart weed we do find mosquitoes breeding. Other than these, I don't recall plants that I would care to say were or were not deterrents to mosquito production.

Mr. Le Prince. I will ask Mr. Johnson to close the discussion.

Mr. Johnson. I think this discussion has brought out a lot of lines along which development is possible. It has brought out a lot of different problems occurring in different parts of the country. I think we should push the particular line, or lines, that seem to be most successful in our part of the country, and when we meet again next year we will be able to talk these things over, and get a lot out of each other's experiences.

Mr. Le Prince. The next paper is "The part biology plays in the dissemination of malaria" by Mr. Bruce Mayne. There is a matter that has come up that will be of interest. I want to ask Dr. Fricks to refer to that matter before Mr. Mayne reads his paper.

Dr. Fricks. Gentlemen, I received a letter from the bureau about a week ago in which I know that all the sanitary engineers present will be interested, and I thought probably this would be a good time to mention it to you. Briefly, the letter stated that at the request of the State engineers a sanitary engineer of this service, Mr. Mendelssohn, had been assigned for duty in the bureau to abstract reports from sanitary engineers all over the country, these abstracts to be published in the weekly Public Health Reports. Monthly reports from malaria field headquarters were requested, covering abstracts of engineering work. Mr. Le Prince will compile these engineering reports dealing with malaria, but I feel sure that he will expect you to assist in the work and that he will let you know how.

I make this statement at this time because you will all be interested and possibly may want to talk it over.

Mr. Le Prince. Send in any information regarding drainage methods or short cuts, matters that might be valuable in our drainage work. The idea is to get the information in as early as possible. In that connection, some of you will develop certain things that you think ought to get to all the other coworkers, and this exchange bureau is arranged for that purpose.

THE PART BIOLOGY PLAYS IN THE DISSEMINATION OF MALARIA.

BRUCE MAYNE,

Associate Sanitarian, United States Public Health Service.

We have 40 years of accumulated knowledge as the basis for future studies in the parasitology of malarial fever and yet a vast field remains scarcely explored. It is to be lamented that there still exists lack of appreciation of the facts concerning malaria transmission, and for this reason I have taken the liberty of reviewing the subject in a nontechnical style so that its scope may be better interpreted.

Until the true cause of malarial fever was discovered in 1880 numerous theories on the origin of the disease were promulgated by the medical profession. Among these, the most acceptable was that proposed by an Italian scientist who maintained that a germ named *Bacillus malariæ*, which was contantly present in the mud of marshes, was the cause of the disease in man. Other theories, half baked and fanciful, were proposed in support of the ancient opinion that bad air and bad water were the natural lurking places for the germs which made the human victim shiver and sweat in the paroxysm of the ague. However wrong these views may seem to us now, we must admit that the haunts in which the disease had its origin were known as well as feared by the ancients and that the Italian name for the disease, malaria (mala-aria—bad air), holds to this day.

Even so recently as 10 years ago certain medical textbooks affirmed, and unthinking physicians even to-day accept the notion that drinking polluted water may give one malarial fever. And despite the advances of scientific medicine certain others are still skeptical that the bite of an infected mosquito is the only way whereby the disease can be propagated. One modern author advances the hypothesis that mosquitoes normally feed on plant juices and infect plants by stinging them with the mouth proboscis in the same manner in which the human blood is infected. It is alleged that such vegetable material eaten uncooked would cause the human host malarial fever through the gastrointestinal tract. The same medical writer believes it possible to contract the disease in two other ways, namely, drinking water in which malaria-infected mosquitoes have laid their eggs and died, and by breathing air laden with the germs malaria-infected mosquitoes have disseminated.

However, these views have been condemned by the careful student of parasitology and the most modern conception of the problem is bound up in the application of experimental proof. It may be pointed out that in contrast to our skeptics in science many wild tribes in tropical countries have long been observed to protect themselves and their live stock against the bites of mosquitoes, for it was a popular belief that these insects were somehow responsible for the propagation of tropical fevers. Yet the scientific world discredited this belief of the uncivilized man until nearly the beginning of the twentieth century, when the combined observations of the founders of modern tropical medicine had established in all its fascinating detail the fact that the mosquito is the constant and necessary vehicle of malarial infection.

Recently, however, medical textbooks are unanimous in accepting the claims of the modern scientist that the microorganisms harbored by certain mosquitoes have been ingested with the blood from an individual sick with malarial fever. This was announced for the first time fully 17 years following the determination of the causative parasite in the human blood. The credit for this important discovery is given to Sir Ronald Ross, a British military surgeon, who in 1898 completed his brilliant researches which demonstrated completely the development of the malaria parasite outside of the body of the human host within the mosquito which perpetuated the disease. Ross was able to follow the cycle within the insect until the parasites harbored were in such a developed form as to be suitable to infect new red blood cells when the mosquito bit another human victim.

Abundant proof of this has been furnished from time to time and ample confirmation of the rôle of the mosquito in malaria dissemination supplied through the medium of experimentation. More than 60 well-authenticated cases of mosquito inoculation of human volunteers have been recorded. Sixteen of these experiments were conducted in the laboratories of the Federal Health Service under the writer's personal supervision, so that the complete story of the part played by the mosquito in the spread of this dread scourge can be told from actual experience.

In order to intelligently appreciate the rôle that the mosquito assumes as a vehicle of destruction it is necessary to describe the condition of the blood in the patient and how he functions as a carrier of these pathogenic organisms. To find these parasites one need only examine the blood of a patient suffering from an acute attack of intermittent fever. This is done by drawing on a glass slide a droplet of blood from a finger or the ear lobe pricked with a surgical needle and examining it by means of a fairly powerful microscope. In this connection, when one views for the first time the germs of the disease which have invaded the human blood cells he can appreciate the thrill of the scientific voyager and share the prophetic vision of the discoverer, the French army surgeon, Dr. Alfonse Laveran.

It was a memorable day for Dr. Laveran when, in a French Algerian military hospital, examining with unbounded patience the blood of the victims of the dreaded scourge of northern Africa he discovered that the cause of malaria was a living organism which destroyed the red blood corpuscles and transformed their contents into toxic substances, giving rise to the classic symptoms of the disease. He had been perplexed a long while in observing one of the minute Amoebalike specks, which were then believed to be nothing more than degenerated corpuscles, when suddenly the cell projected several long, slender filaments which began to move about very actively, lashing and displacing the surrounding corpuscles. This was accompanied by a peculiar turmoil of the brassy black granules within the cell. Thus was revealed the animate nature of these bodies and was proclaimed the real cause of the febrile disturbance in the patient's blood.

It may be noticed that in an examination of a drop of blood a certain number of the red corpuscles exhibit a tiny whitish form which continually alters its shape very much like a gas flame, which, during a gust of wind, flickers within its glass globe. These movements of the parasite are called amoeboid because they characterize the movements of the Amoeba, the simplest member of the animal world, consisting of a single cell of living protoplasm. And although it has no constant definite shape, the Amoeba in this instance can assume a threadlike fineness and pierce a red blood corpuscle as it migrates, after its function of corpuscle annihilation, from cell to cell in the blood stream. Some hours later the parasite in its metamorphosis will have increased in size elaborating minute brassy black grains called pigment granules, the product of the haemoglobin, the substance contained in the red corpuscles which the parasite is constantly engulfing with its jellylike body. These pigment granules gradually become shifted toward the center and help to give the parasite a daisylike appearance when it has finally broken up into a number of segments. When this rosettelike arrangement is perfected the red blood corpuscle bursts open like a seed pod and the segments, forming new parasites, escape into the blood stream and are able to penetrate new red cells. Thus the life process is repeated and when the new invader has grown to about the size of the corpuscle and exhausted all its foodstuff, the partition of the new organism progresses indefinitely as before.

This cycle of development in the parasitic Amoeba, which has taken place wholly within the body of the human host during 48 to 72 hours, gives rise to definite clinical symptoms of the disease, and when at least 25,000,000 of these invaders are present a paroxysm of chills and fever results. After two or more of these paroxysms, when several generations have passed during the growth of the invading organisms, an examination of the blood reveals peculiar forms assumed by numbers of the parasites. They appear as blunt-ended crescents with transparent bodies and clumps of black granules in the center. In others, depending on the species of the malaria parasite, these bodies are quite ovoid, resembling the matured forms preceding segmentation. They are now the resting spores or gametes, and, like the spores of the bacteria, are able to survive in a quiescent state the unfavorable conditions of growth in the living medium.

It is now high time for the villain of the tragedy to enter, for it is during this period of passive life that the gametes require some external vehicle for continued development. This is offered in the ideal form by a preying mosquito which, invading the haunts of man at dusk, chances to draw its fill of blood from a parasitized person. It is necessary for the completion of our story that this mosquito be a female belonging to the genus *Anopheles*, with spotted iridescent wings and long delicate palpi. The protozoan malaria organism seems to have a peculiar affinity for insects of this sort, for thus far no other genus has been found capable of cultivating them. The dormant parasite thus enjoying a change of host suddenly awakes to renewed activity, changes its form from crescent to round, throwing out long filaments which leave the body of the cell and are seen to attack organisms of the opposite sex which in natural course of favorable development are penetrated and fertilized. After fertilization within the stomach of the mosquito the new parasite transforms, becoming more elongated. Then acquiring movement, it is enabled with its spiked end to pierce the several stomach linings of the insect, finally lodging on the muscular wall of the organ, assuming a globular shape. It soon becomes encysted, though still able to partake of the generous blood supply that accompanied it when it was taken within the gnat's interior.

The cyst now organized becomes inclosed in a structureless, transparent capsule growing to many times its original size. In a parasitized Anopheles the entire stomach wall appears festooned with tremendous numbers of these tumorlike masses of protoplasm which break up into a number of tiny spheres. Minute spiny processes appear on these segmented spheres which, growing longer, separate from their attached cells, appearing as prickly filaments within a sac. Then the membranous sac or capsule bursts and these filamentous, spindle-shaped organisms, the sporozoites, stream forth like a school of tadpoles into the body cavity of the mosquito. It is now a speculation as to the behavior of these bodies, but we know that somehow the sporozoites are carried by the body juices of the insect to its salivary glands, where they establish themselves, mixing with the saliva of the insect host. When the mosquito bites a healthy person it injects with its saliva a great number of these very active new parasites, the sporozoites, which are introduced to begin again the rejuvenated, endless cycle. These sharp-ended bits of protoplasm begin the struggle by first penetrating red-blood cells, doubling end to end, shaping themselves into rings, each of which develops rapidly into a jellylike Amoeba, the shapeless, active form in which it entered its parasitic career within the blood of the human host.

Thus we have rehearsed a typical biological cycle of 10 days with stages of growth characteristic of a disease-producing parasite.

It would be logical at this juncture to discuss some of the essential factors which retard or accelerate this biological development. And the first that comes to mind, the most influential in the life of any organism, is the factor of temperature. Temperature has both an internal and external influence in association with parasitic life in the mosquito. There is a period which is critical during the time of the fertilization of the human blood parasite in the mosquito's stomach, for it has been learned that this process does not take place if the temperature falls below 60° F. Even should fertilization be successful, the temperature conditions must be favorable until the time of the development of the forms which, after leaving the stomach wall, lodge in the salivary glands and escape through the suctorial mouth.

It is on this account that the malaria organisms are killed off during the cold days of winter; and although the mosquito lives in a dormant stage, it emerges from its sleep as innocent of carrying disease germs as though it had just emerged from its watery cradle in a preceding stage of life. We must note in passing that it is "man's inhumanity to man" that is alone responsible for perpetuating the disease during the hibernating period, for he is the true winter carrier of malaria parasites; and the finger of scorn must be withheld from the mosquito until the warm days of spring make her again culpable.

To interpret the full significance of the insect's rôle as a disease carrier, let us get an insight into its power in ways pathological. How many persons can a single mosquito infect and how many germs is it necessary to inject into one's blood to convey the disease of malaria? Also with the same breath we inquire, How long will a mosquito once infected with these germs remain so? Now, it may be interesting to observe that up to three years ago the conscientious investigator could honestly shrug his shoulders and throw off the burden with "I'm sure I don't know." but to-day certain researches have brought to light at least approximate answers to these riddles.

Indeed, all of these points have been investigated, and though not completely solved, have shed rays of hope on prospective researches. Since these queries are concerned intimately with the operation of biting, we can judge more clearly by reviewing briefly the method involved. If one is sufficiently curious and interested and will permit a hungry (though healthy) mosquito to alight on the back of the hand he can learn enough at one application to be quite convinced. With the aid of a hand lens if one observe the actual blood sucking after the preliminary selection of site for the drilling, it will be apparent that an appreciable time elapses from insertion of the mosquito's beak to the appearance of the drawn blood as it rises in the alimentary tube. The phenomenon is appreciated by the careful surgeon who reverses the operation when in injecting a fluid into the patient's vein he plays safety first, insuring the needle's position by drawing some of the blood into the barrel of the syringe before pressing down the plunger and releasing the contents.

In the first few seconds of biting really all of the mischief is done both as to physical damage to the feelings of the host and the inoculating of the infecting organisms, for it has been proved that mosquitoes inject their poison before commencing to suck blood. This is accomplished by the insect, which in attempting to lubricate the mouth parts in "clearing for action," deposits its saliva in which are mixed the virulent organisms. Then whether it gets its meal or not, if interrupted at this stage, it has already accomplished its function as a disease bearer by introducing the poisonous fluid into the wound. The pumping of the blood to satisfy the mosquito's nutritive demands is therefore incidental. At any rate, it has been actually proved that when mosquitoes were allowed to bite two volunteers for periods of 35 seconds and 50 seconds, respectively, illness resulted in both instances, demonstrating beyond a doubt that virulent parasites had been introduced in these short, interrupted bites. In the same series of experiments it was demonstrated that several persons, at least three, could be successively infected from the bites of a single mosquito.

Relative to the length of time mosquitoes remain infected, it must first be ascertained what is the life of a mosquito. This having been recently determined in our Memphis laboratory to be as long as 185 days, should it prove to be true that an Anopheles mosquito can remain infected as long as it lives it will contribute to our knowledge in attempting to explain certain mysteries of no inconsiderable sanitary importance. So far, however, experimenters have not been able to cultivate in their laboratories mosquitoes which can communicate the malaria disease germs beyond 60 days, and although organisms may be present for four months they appear to be without life.

In our review of the mode of carriage of a menacing insect-borne disease, we have found that a mere trifle—"a trifle as light as air"—has been the cause of it all. It is asserted that man digs his grave with his teeth; it is far more certain that the mosquito's teeth have dug many a grave. And the victory of science in drawing the teeth of the vicious mosquito has blazed the way for scientific control of sanitation and health, and has made possible such achievements as the domination of the white man in the Tropics.

At this juncture it may be an aid to speculate on the bench problems in malaria epidemiology, unsolved and most desirable of solution. This being a practical dollar and doughnut world, the modern biologist is no longer an academical research theorist, but must be primarily a sanitarian—a 100 cents on the dollar sanitarian. Therefore we are prompted to indicate at least some of the more interesting if not more vital questions upon which more light is required. A mere mention of these is all that is necessary.

PROPOSED INVESTIGATIONS.

1. Would the destruction of all forms of mosquitoes in a region during the winter insure immunity to malaria the following season?

2. Do mosquitoes infected in the late fall rid themselves of malaria parasites during the winter months by attacking live stock housed in warm stables?

3. How late in the season does the mosquito cease to be a menace in malaria transmission?

(When to discontinue oiling and lay aside precautionary measures.)

4. How early in the spring does the mosquito become effective as a carrier of malaria?

(When to begin oiling and screening, and if desirable to consider quinine prophylaxis.)

5. The length of time an Anopheline mosquito once infected remains so.

This question is in my opinion one of the most vital and incidentally one the solution of which is greatly sought by investigators the world over.

6. How soon after draining an area of land does the aquatic life of Anopheles become extinct? Do mosquitoes in the young stage survive drying out or thrive in semidried mud? Can eggs of Anopheles survive dessication?

7. Mosquito predilection for food—Can domestic animals be utilized to attract mosquitoes away from the domiciles of man?

(Can live stock be used practically to establish a barrier in the nature of bait between areas of mosquito propagation and human habitation?)

8. A satisfactory substitute for the much-abused salts of quinine. (Any agent which will accelerate parasite destruction and shorten treatment.)

9. The value of the differential leucocyte count in the diagnosis of malaria in blood examinations.

Such a test might be valuable as an aid in diagnosis particularly in the absence of demonstrable blood parasites. Thus far in a critical study of some 400 positive malaria blood specimens nothing specifically characteristic has been observed.

DISCUSSION.

Mr. **LE PRINCE.** The paper is open for discussion. May I ask Dr. Barber to make a few remarks?

Dr. **BARBER.** Mr. Mayne has made clear some very important phases of the problem of malaria. As regards the popular knowledge of malaria, a subject which may more properly belong to the discussion of an earlier paper, I may be permitted one or two observations. In the course of some house-to-house work in Arkansas I have very rarely found people who were not familiar with the fact that malaria is transmitted by mosquitoes. That mosquitoes are the sole vectors of malaria was questioned by a few people, among them one or two health officers, who cited cases of reduction of malaria coincident with improvement in a local water supply. In discussing this matter with them I readily admitted the possibility that any measure which would reduce intestinal disease might reduce malaria morbidity, since such a disease might provoke a latent malarial infection into activity. One would not admit, of course, that water could ever act directly as a vector of malaria.

Dr. **COOGLE.** There is no doubt in my mind that malaria is transmitted to the human being only by mosquitoes. Feasible and practical methods for its control are known; means for its eradication are to be perfected.

Practical methods of eradicating malaria will probably be worked out after the solving of the engineers' and the doctors' problems. Malaria is a man-to-mosquito-to-man disease. The doctor's problem is the man; the engineer's problem is the mosquito. Together, the doctor and the engineer must educate the people to all the known practical methods that will lead to malaria eradication.

Mr. Mayne's paper is an excellent one.

Dr. **HARRISON.** Mr. Chairman, I can not refrain as a physician from expressing my admiration of Mr. Mayne's paper. I have listened to a great many papers on the subject of malaria transmission and this has been an extremely concise and clear-cut explanation of the subject, and I should think that to a body of sanitary engineers it would be of unusual value. You will often be called upon to give more or less this same explanation to the public, and it seems to me in all public-health work, that before we attempt to disseminate knowledge we should be extremely sure that we are familiar with our subject, and that we are giving to the public facts that can not be questioned. It appears to me that every engineer present would do well to know in the future that he has thoroughly understood this paper, and has gotten all of the points clearly fixed in his mind. It would be a very valuable paper, not only for a body of engineers, but for any body of doctors to have heard and to have gotten thoroughly fixed in their minds. It is a clear-cut explanation of the life cycle of the malaria parasite and the method of transmission of malaria. I may say that a favorite State board examination question for doctors is to describe the life cycle of the malaria parasite.

Mr. FISHER. Mr. Chairman, I wish to make two observations that will probably be of interest in this case.

At Chester, S. C., which is a *punctipennis* country, our census indicated that approximately 7 or 8 per cent of the people there had malaria, which, I think is somewhat interesting in showing to what degree *punctipennis* is an agent in carrying the disease.

The other observation is that at Bamberg through certain circumstances oiling was delayed or discontinued for about two weeks right in the middle of the season, which, of course, released a brood of mosquitoes. They persisted in the community for about three weeks, which gives some idea, I think, of the length of the life of Anopheles in nature.

Mr. STROMQUIST. Without the work of a laboratory man the malarial parasite would not have been discovered, and we engineers wouldn't be in this work to-day. Without the work of such men as Mr. Mayne, who are studying different problems and developing these things we wouldn't progress in the work, and it is up to the engineers, who as a profession must use all available means of knowledge to apply practically, to make use of this knowledge that Mr. Mayne and others are developing for us, and it is also up to the doctors to do the same thing.

We find in our work any number of doctors who mention this theory of transmission by mosquitoes. Just a few days ago in Memphis a man brought in a sample of city water to me and wanted an analysis. I asked him if they had any sickness there, and he said two cases of fever. I said, "Typhoid fever?" He replied, "No; malarial fever; and the doctor tells us it is probably due to the water."

Mr. VAN HOVENBERG. In regard to the question of eradicating malaria through the elimination of human carriers, I would suggest that the function of the malaria parasite in man was known to medical science as early as 1880. With due respect I would say that it is only within the past four years that we have begun to make history in reduction of malaria in the United States, principally through mosquito control. [Applause.]

Mr. Le Prince. One point brought out in the discussion is of interest to me—this persistent talk about connection between drinking-water supply and malaria, and I have often wondered if this large increase of screening has been done simultaneously with the improvement of the water supply.

Mr. Mayne will please close the discussion.

Mr. Mayne. I would like to close my paper, Mr. Le Prince, by showing these photographs.

This first photograph is a graphic reproduction of the life cycle. We will pass that around and see it at close range. It is a little scheme that I sketched to show what takes place in the blood of man and in the mosquito's body.

Some of you may be interested in the different species of the Anopheles. This photograph will show you the difference in the wing structures of the *quadrimaculatus* above, the *crucians* in the middle, and the *punctipennis* at the bottom, and I think if you will look at this your observations in the field will indicate to you the difference very readily. The posture of the mosquito is shown. You will readily recognize the posture of the Culex and the Anopheles.

This is the head of a female showing it in the act of projecting its lancets in biting. This is an enlarged photograph of the salivary glands, through the thorax; you can see the relative position of the salivary glands. Here is the stomach of a mosquito showing the parasites on the stomach wall, which contains bundles of these filamentous parasites. That is another of the same, showing the tremendous multiplication. This is a camera lucida drawing, by the way; each one of those oocysts actually occurred on the stomach wall of the mosquito.

Mr. Le Prince. The next paper is " Oil burners as weed killers," by Mr. Shaw.

OIL BURNERS AS WEED KILLERS.

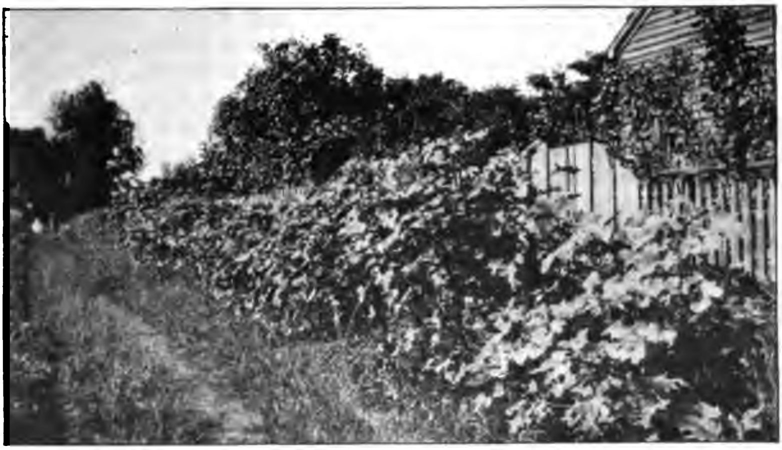
Frank R. Shaw,

Assistant Sanitary Engineer, United States Public Health Service.

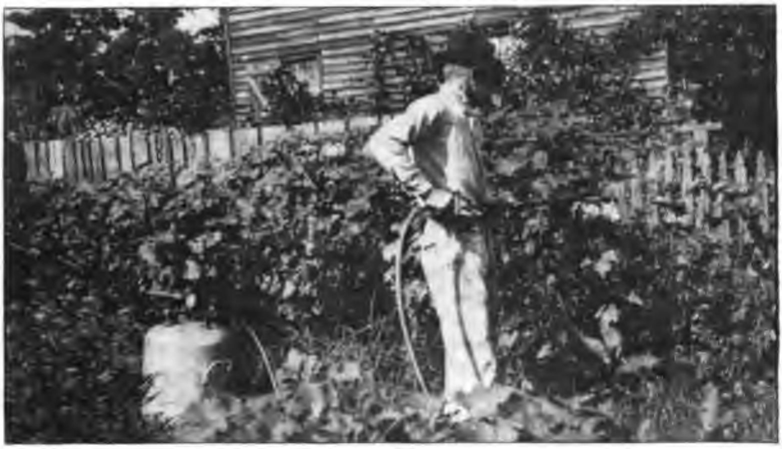
An investigation was made in Baton Rouge, La., to determine the effectiveness and economic efficiency of a standard kerosene burner used in the destruction of vegetation which is found adjacent to water courses. The consideration of effectiveness involves only the results accomplished, whereas the economic efficiency takes into account the cost as compared to other methods. The initial cost might be greater than other methods, but the lasting quality of its effect might prove the economy of the method. In other words, if it is necessary to clear certain streams three times during the season by hand, and burning once would accomplish the same results, then burning would be justified if the cost was something less than three times the cost of clearing by hand.

Before going into the details of the work I shall give a description of the apparatus used. The kerosene burner consists of a steel tank of sufficient size to contain 15 gallons of oil and a proportionate air space above. The tank is equipped with a double-acting, long-stroke pump which has automatic valves, a pressure gauge, and two burners each connected by a long rubber hose to metal pipes reaching to the bottom of the tank. The burner consists of a straight line of pipe and a coil at the end. The oil passes down the straight pipe, through the coil, and back to the base of the coil where it is atomized through a nozzle. In starting the operations the supply valves are closed, the burner coils heated until red and the air pressure brought to 40 pounds. Then upon opening the supply valves the oil is forced through the hot coils where it is vaporized and when sprayed from the nozzle readily ignites from the heat of the coils. It produces a bluish flame about 30 inches long and 4 inches in diameter. If the coil is not heated sufficiently before starting the blaze will be unsatisfactory; it will give forth a reddish flame which is of low heat value.

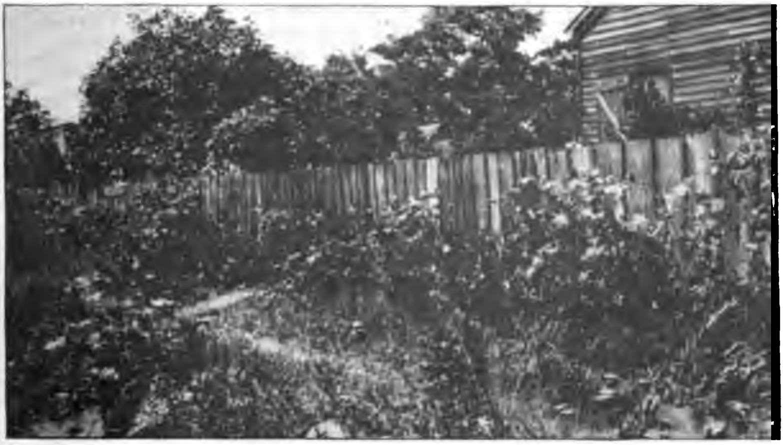
While operating the burner I used the full-time services of a foreman at $5.83 a day, two laborers at $2.75, handling the nozzles, using two nozzles continually, and one laborer at $2.50 operating the pump. On the hand cutting I used a foreman at $5 per day (figured as directing 10 men) and two laborers at $2.50 per day. I made the comparison of these costs considering the laborers only, but I am



Before.

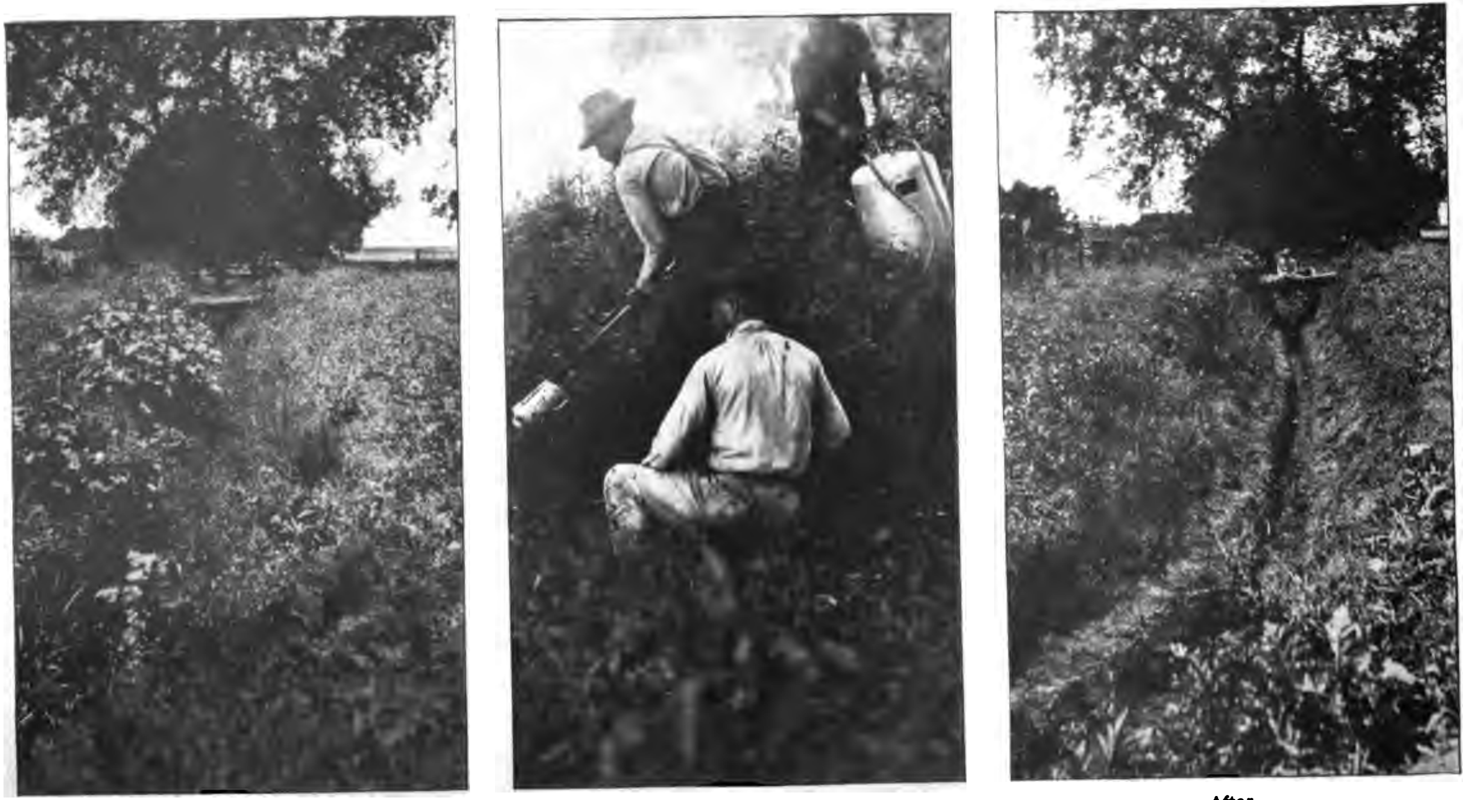


Burning.



After.

FIG. 3.—INITIAL WORK.



Before.

Burning.

After.

FIG. 4.—MAINTENANCE WORK.

of the opinion that the burners would not be operated very satisfactorily without some supervision by a person of more intelligence than the average laborer. I think that in operating two burners it is necessary to have three men, one at each nozzle and one at the pump keeping the pressure up to 40 pounds. As soon as the pressure is reduced to 30 pounds the coils seem to cool, and we soon have a low red flame, necessitating the reheating of the coil.

On the initial work, consisting of low grass and cocklebur bushes, about 4 feet high, on a length of 50 feet and a clearance of 5 feet, the burning costs 7 and 5 cents a foot, respectively, with and without the foreman. In addition to this it was necessary to do some hand clearing which cost 1 cent a foot. This brought the total cost including the foreman to 8.2 cents per foot and excluding the foreman to 5.8 cents per foot.

On another section of the same ditch having a like growth of vegetation, the work by hand, including the foreman, cost 0.48 cent, or approximately a half cent, per foot; without the foreman, 0.4 cent per foot.

The maintenance work consisted of a ditch which had been initially cleared a month and a half or two months before and was just at the stage where it was necessary to clear to get effective oiling. The vegetation had grown from each bank and had met so that it was not possible to see the channel we had previously cut. This work was conducted on a length of 177 feet. The operation of the burner, with the above-mentioned pay for laborers, including the foreman, cost 2 cents per foot; without the foreman the cost was 1.4 cents per foot. The handwork on this maintenance operation, on a like section of the same ditch, including the foreman, cost 0.4 cent per foot; without the foreman the cost was 0.35 cent per foot.

It will be observed that the use of the burner on fairly heavy initial work cost approximately sixteen times as much as the handwork; on maintenance work approximately five times as much as the handwork. The ratio is about the same with or without the foreman—close enough to put it in round figures. In two and one-half months the same growth covered the channel in the case of the maintenance example.

Another experiment was conducted in using this burner to destroy aquatic growth. Adjacent to Baton Rouge is University Lake, which contains a very heavy growth of *Myriophyllum heterophyllum*. Previous to this experiment we had cut 3-foot channel ways in this growth to admit Gambusia to the edges, and the control effected was very satisfactory. The work was done on the same basis as the hand cutting mentioned above and cost 3.6 cents per foot.

The burner was used to burn 3-foot channel ways for a length of 30 feet. Only one nozzle was used and the personnel consisted of a foreman at $5.83, one laborer at $2.75, and one laborer at $2.50 per day. The cost was 3 cents per foot, only a difference of 0.6 cent. This was not found satisfactory, because this growth, although we burned the top off, was so thick just under the surface of the water that it did not allow the minnows to reach the shore edge, whereas hand cutting gave very satisfactory results in this regard.

On another section of the lake bank where there was a very rank growth we made an observation as to the effect of using the burner along the bank, and I think in many places it might be very effective. At this place there was a very heavy growth of vegetation extending out about 20 feet from the bank. Vines and brush of all kinds present would have involved very heavy hand cutting to provide access to the lake's edge, whereas in a boat we could go in and about the edge and throw a flame that cleared out the underneath part of the vegetation. We could throw the flame a considerable distance and thus provide clearance for inspection along the shore where progress would have been impossible previous to that.

Accompanying this paper I submit several photographs which clearly show the nature of the work.

Discussion.

Mr. Le Prince. I would like to hear from Mr. Lenert if he has done any of this burner work.

Mr. Lenert. I did a very small amount of this work due to the burner coming in late in the season.

We had one ditch, the head of the principal drainage system through the town, grown up with weeds to a height of 5 or 6 feet. The growth was very heavy and the cost for hand cleaning with hoes and shovels would have been very heavy. Work on this ditch was started with the burner and very good results were obtained on the growth near the ground, but being a very windy day, after the work had progressed about 40 feet it required the efforts of four men to put it out, and this work was discontinued. The ditch bordered a lumber yard and there was considerable danger of the fire spreading to proportions beyond our control.

We did try it on a ditch that had given us considerable trouble, being fed continuously by the leakage from a broken water main. The ditch contained water to a depth of about 6 inches and averaged about 5 feet wide. It was heavily overgrown with tall grass, Bermuda and some aquatic plants, to such an extent that the surface of the water could only occasionally be seen. This ditch was burned off to the surface of the water, burning all of the light growth and scorching the heavier plants in such a manner that they would die, for a distance of 250 feet and a width of 6 feet. The cost may be itemized as follows:

1 foreman at $4.81 per day (1⅓ hours)	$0.64
2 laborers, at $3.50 per day (1⅓ hours)	.94
6 gallons coal oil, at 19½ cents per gallon	1.17
Total	2.75

This would indicate a cost of approximately 1.1 cent per linear foot. One-third more would be necessary to complete the burning of grass and weeds killed but not consumed, making a total of 1.5 cents per linear foot.

I believe the burner has a real value; while not taking the place of hand clearing, in some places, as in clearing the edges of ponds and lakes, it should prove far superior to handwork. We had one in particular surrounded with Bermuda grass. It would have been very valuable there in burning the grass to some distance above the water line, lowering the level of the lake some 6 or 8 inches before starting burning.

I would also like to experiment with the burner by first applying crude oil to the vegetation in a sufficient quantity to cause the tops to die and then applying the burner. There is no doubt that it has its good points and we have not yet discovered all of them. More thorough trials should be made.

Dr. Ferrell. The problem of getting rid of vegetation is extremely important. The work of Mr. Shaw is most interesting. However, it would probably be necessary to continue his experiments before we should be justified in drawing final conclusions as to the value of this method of control.

In the Southern States, the growth of vegetation and the production of mosquitoes is seasonal. As we go farther into the Tropics, both go on for 12 months of the year. There malaria is an even greater menace to the health and working efficiency of the people. The task of giving them relief lies ahead, and as opportunity offers, we should be constantly on the alert to find methods that will give them freedom from malaria. In the Tropics particularly, the cost of burning vegetation will probably be found prohibitive.

I should like to inquire if the experience of the sanitary engineers would lead them to feel that vegetation in many localities may be controlled by inclosing them with fences and utilizing them for pastures. In certain localities it has been feasible to collect the water in malarious areas within definite banks; control mosquito breeding with fish; and to pasture the banks with cattle and sheep, and thus control vegetation at a minimum expense.

Mr. Fuchs. Only certain kinds of vegetation are eaten by cattle. The question is, will cattle destroy the coarser and ranker growths that infest ditch banks? I have seen places where the vegetation was very closely cropped in the pasture, but on the banks of the ditch there were heavy growths of vines, shrubs, and briers that were not touched by the cattle. The beneficial effect of cattle on marginal vegetation is therefore questionable.

On the other hand, the cattle will trample ditch banks and leave hoof prints that will often become bad breeding places. Usually, then, the advantage to be gained from the removal of vegetation will be more than counterbalanced by the evil effects of hoof prints of the cattle.

Mr. Le Prince. I believe it is largely a question of topography. I have seen places in Louisiana where the grass is kept cropped close to the edge of the water. On the contrary, in my southern experience, time after time, we have found it better in handling certain areas, to keep a wire fence around a place to keep the cattle out of the place when we had a continuous rainy season. We have been able in some instances to get the farmers to pay for such work; in other instances we had to pay for it ourselves.

Mr. Woodfall. I had a little experience along this line at Raleigh, N. C. We had a very bad low, swampy land under control. This piece of land had given us a great deal of trouble, due to local topographical conditions.

After the land was drained it was bought by a local man at an increase of 75 per cent above its original price and was used as a pasture for horses, cows, mules, and goats. We found that a combination of all these animals kept weed growth at a minimum, due to the fact that each type of animal would eat different types of growth.

From the maintenance standpoint we found the keeping of cattle was very expensive, even considering the factor of weed and grass control. As a final method the man was compelled to fence off all the ditches, keeping the cattle away from them.

Mr. Le Prince. Is there any further discussion?

We may find places where cattle can be used to advantage. There are many, of course, where fencing may have to be used.

The question of weed control or vegetation control is so important that much more investigation work must be done.

The next paper on the program will be "Culex control," by E. H. Magoon. This question should be seriously considered, but in our discussion let us omit unnecessary details; be brief, give us points of importance, and remember that we have to finish to-day.

CULEX CONTROL.

E. H. MAGOON,

Sanitary Engineer, International Health Board.

The control of Culex breeding is an important factor in an antimalaria campaign. The cost of accomplishing this is often greater than the cost of controlling Anopheles breeding. As an illustration of this, I mention spending $100 on inspections of wells, cisterns, and private containers at Trinity, Tex., during July, 1920. The same month $13 was spent on oiling and $35 on ditching and filling. The $13 and the $35 did much to control Anopheles breeding, but the $100 gained the friendship of the people, and made them think the whole $148 was well spent. Trinity is a town having about 330 houses, 145 metal cisterns, 130 underground cisterns, and 60 open dug wells. This town of 1,250 population is typical of other east Texas towns of its size. Its mosquito problems are chiefly ones connected with wells, cisterns, rain barrels, drains, septic tanks, and foul ditches.

Probably few people, other than experts, readily find Anopheles mosquitoes. This season I visited a school in South Groveton, a town where Anopheles breeding seemed particularly extensive. Twenty-five students brought mosquitoes they had caught. Not one of the specimens was Anopheles. I recall questioning different people about mosquitoes in a severely infected malarial district of Greek Macedonia in 1916. I was told that there were practically no mosquitoes. It was a district where Culex breeding was negligible, but a few Anopheles breeding places could be found. I mention this as it will serve to caution one against expecting that malaria reduction will necessarily result when one secures good control of annoying mosquitoes.

The warfare against Culex mosquitoes does more than make the work popular and insure continuance of appropriations for antimalaria measures. It assists directly in the control of Anopheles. This past season Anopheles larvæ were found in common Culex breeding places. I make mention of finding:

Anopheles punctipennis breeding in underground cistern at house No. 278, Groveton, Tex., July 13, 1920.

Anopheles in six open cisterns at Groveton, Tex.

Anopheles quadrimaculatus in wooden watering trough near pond 17, Trinity, Tex., August 20, 1920.

Anopheles punctipennis in fire barrel at first railway bridge east of station at Corrigan, Tex., October 16, 1920.

Anopheles in nearly empty metal cistern near waterworks tower at Livingston, Tex., June 29, 1920.

Anopheles in cans, kettles, and tubs standing in or near the edges of streams and ponds.

The surface position and shyness of the Anopheles wrigglers hinders one from finding them in wells and cisterns. Most of the open wells and uncovered cisterns were stocked with fish early in the year and in consequence relatively few such places were found breeding mosquitoes of any kind.

The campaign against Culex breeding at Livingston, Tex., is outlined below.

1. Plat was prepared showing location of all dwellings, as well as streets and watercourses.
2. City council passed ordinance against mosquito breeding and solicited aid of ladies in the malaria census and educational activity.
3. Group of interested women was instructed concerning mosquito-breeding places and purpose of the campaign.
4. Some instructions and questions pertaining to screening of cisterns, downspouts, and cesspools and to stocking wells and underground cisterns with fish were printed on the reverse side of the malaria census cards.
5. These cards were used by the ladies who were securing data concerning mosquito-breeding places, and who were giving information about the antimosquito ordinance and methods of complying with it.
6. Census cards were looked over by the sanitary inspector, and fish were supplied to people who had replied in the affirmative to the question, "Does the owner wish fish put in the well or underground cistern?"
7. The first inspections indicated that 40 per cent of the premises were breeding mosquitoes. An inspection in August indicated that mosquitoes were breeding at only 10 per cent of the houses. The data secured by the inspections was published in the local newspaper.
8. A gummed poster bearing the words, "Warning; mosquitoes found breeding here in violation of health ordinance; abate nuisance," largely took the place of written notices. The poster was gummed on the reverse side so it could be readily applied to a galvanized iron cistern or a well bucket.
9. Opportunities were secured to inform interested people concerning mosquitoes and measures to prevent them. School children were shown exhibits of Culex, Aedes, and Anopheles larvæ and imagoes, and detailed instruction given concerning breeding places of the different kinds of mosquitoes.

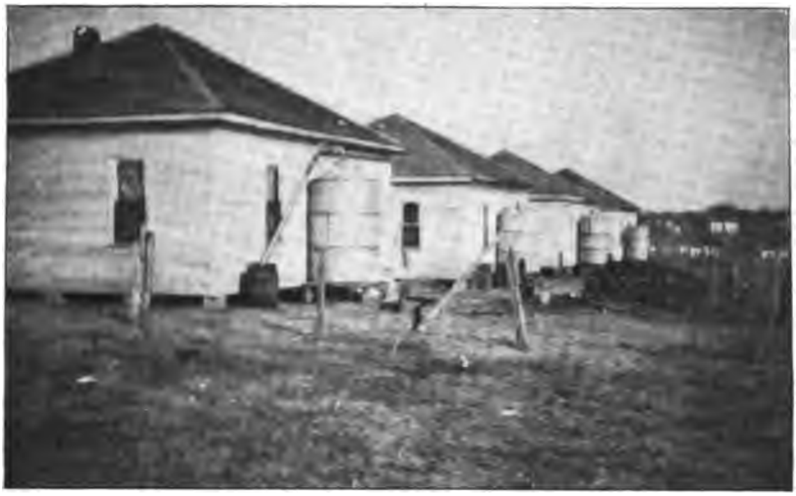


FIG. 5.—FOUR OF THE 145 METAL CISTERNS AT HOUSES IN TRINITY, TEX.

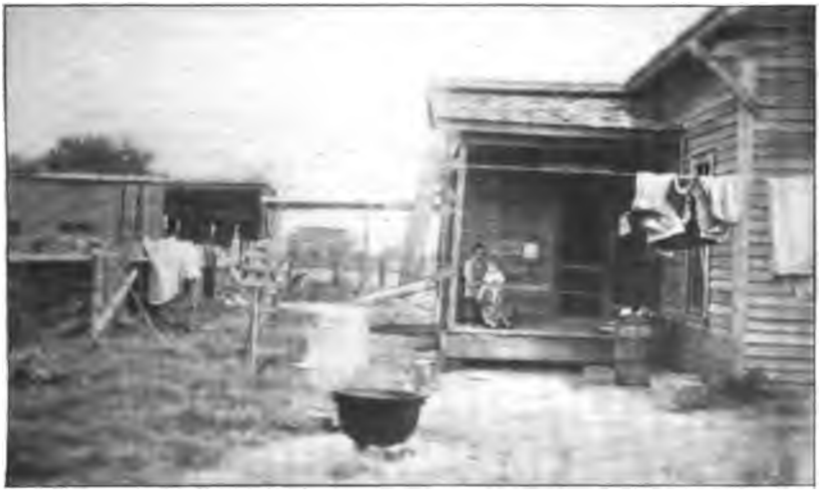


FIG. 6.—CULEX AND ANOPHELES LARVAE WERE FOUND IN THE UNDERGROUND CISTERN TO THE LEFT OF THE HOUSE IN GROVETON, TEX.

The results of the campaign were most encouraging. People began to think of the mosquito problem as a local one. They were themselves able to locate and abate all mosquito nuisances.

Catfish, perch, and Gambusia have been used in the fight against mosquitoes. The catfish will keep a cistern or well free of wrigglers. Three pairs of Gambusia were just as effective as one or two catfish and there was not the danger of the fish dying and spoiling the water. Oiling with kerosene or gasoline will not kill the Gambusia. In June about 1,550 perch were seined and placed in fire barrels at the Rock Creek Lumber Co. Inspections showed that the two tiny perch put in each barrel grew rapidly and the barrels were free from mosquitoes.

Gambusia have been successfully used in preventing mosquito breeding in fire barrels, stock troughs, and rain barrels. Experiments showed that they would live neither in galvanized-iron cisterns nor in water drawn from them.

Mosquito larvæ do not appear to be harmed by blocks of red cedar floating in the water. Small films of oil seem to have little or no effect in killing larvæ in septic tanks.

DISCUSSION.

Mr. LE PRINCE. I would like an expression from Mr. Hildebrand regarding other fish than catfish.

Mr. HILDEBRAND. Mr. Chairman, experiments show that when fish are confined in containers almost any species may be used. Fish will eat what is available under these conditions even though it is not its natural food. I have used a strictly herbivorous fish and placed it in a pool where no plants were available but which produced Culex prolifically, and got absolute control. Place that same fish in an aquarium, or pool, with plant food and it will not notice a wiggler. I think in containers any species that may be handy can be used, but catfish may have advantages over the Gambusia or any other fish, because it is so hardy.

Mr. VAN HOVENBERG. I want to ask if Gambusia will breed and multiply in containers?

Mr. HILDEBRAND. In Key West, Fla., in cooperation with the naval health officers we stocked half a dozen cisterns with Gambusia, and they multiplied rapidly, but they never became abundant enough to cause any damage to the water. You know that Gambusia is a cannibal. When other food is not available it will eat its own kind, and they do not appear to become abundant enough to do any harm to the water.

Mr. LE PRINCE. Another point in this matter of Culex control is the cost. It must be generally known that Culex control is essential.

Unquestionably many of you have found it advisable to take up Culex control.

I would like a general expression of opinion, just a few words from each one of you, as to what you spent for Culex control—whether you did $50 or $100 worth of work on Culex control. Has your Culex control been, say 10 or 50 per cent of your entire cost?

Mr. SHAW. I believe that the success at Baton Rouge in winning public sentiment was largely due to Culex control. The Culex control in Baton Rouge cost two-thirds of the total cost of oiling.

Mr. FUCHS. In North Carolina the per capita cost this year averaged $1.25. At least 25 per cent of this was for Culex control.

Mr. LENERT. In Monroe, La., I should say 10 per cent of the cost of oiling and maintenance cost, exclusive of ditching, was for Anopheles control. In Bastrop hardly more than 20 per cent was spent for Anopheles as against Culex control.

Mr. DAVIS. I think in the work at Savannah we can safely say that 60 per cent of our mosquito control was for Anopheles.

Mr. LE PRINCE. Is there anybody here who thinks that the Culex control can not be omitted from our scheme of work? We would like to hear something along that line. Please be brief on these matters. Let us have a little further expression of opinion as to whether or not the public will stand for a continuance of malaria control work if the Culex elimination is omitted.

Mr. PARKER. I do not believe that in the majority of cases that the towns will want to continue the work unless we do Culex-control work. We have to conduct a mosquito campaign.

Mr. LE PRINCE. Just a minute, please, before further discussion. I want to ask this: Those who agree with Mr. Parker will please rise. Will somebody please count. Twenty-three.

Now, will those who believe the contrary please rise. Two.

Mr. HOSKINS. I believe that in rural malaria control, less attention need be paid to elimination of Culex than must be given in a thickly settled community. In a well-developed area, where Culex have been a pest, it has been my experience that this type must be eradicated if a campaign is to have continued local moral and financial support. On the other hand, officials of rural, malaria-infested territory will more willingly support a strictly antimalaria campaign, probably because of a higher rate of incidence of the disease.

Mr. LENERT. The work started by Mr. Hardenburg was continued by Mr. Park, one of Mr. Magoon's trained men. At Navasota, Gambusia gave 100 per cent Culex control in a small creek. At Bryan they were used with signal success in dug wells and underground cisterns. At Calvert they controlled a long culvert that had previously given much trouble.

Gambusia are naturally present in large numbers in branches on the edge of Cameron, and it was found that one man using fish could handle the mosquito situation in town where it had required the use of two when oil alone had been used. In placing fish in street ditches and culverts they were allowed to dry up with the water, being replaced after the next rain.

This same procedure was followed in Monroe, La., by myself, using fish, which were very abundant in all the streams and ponds, in street culverts, ditches, etc., and it was found to be far superior to oiling in efficiency, speed, and cost where water continued standing for three weeks or more. They did not thrive in the outlet of a sewer overflow, however. Twelve hundred feet down the ditch, the same being fed from no other source, Gambusia were very plentiful.

I would like to make an observation noted in an inspection at Bastrop, La. After a rain a stock pond overflowed and the creek below contained some small holes, in one of which I found about a half gallon of water. In this water there were five catfish from 4 to 7 inches in length and two perch from 2½ to 3 inches in length; no Gambusia. Along with them, floating on the surface, were five Anopheles larvæ nearly ready to pupate. It is possible that catfish may be better used in Culex control than in Anopheles control, due to the position of the larvæ on the water. It has been suggested to me that the use of catfish should be superior to Gambusia in underground cisterns, due to its habit of feeding in the dark, while Gambusia requires more light for feeding. Catfish used should not be larger than 2 inches in length, though it is claimed by a resident of Trinity, Tex., according to Mr. Park, that a single catfish in a dug well without a cover has kept it free of mosquito larvæ for eight years, where previously it had been a veritable hatching ground for mosquitoes. This catfish is still operating.

Mr. DeMott. From what I understand we are trying to conduct malaria control, are we not?

Mr. Le Prince. We are.

Mr. DeMott. If you have not funds enough to finance Culex control I think for the betterment of humanity you should conduct malaria control and let the Culex bite as much as they want.

Mr. Le Prince. We haven't yet got to the point that you have. We hope to get there when we can have county funds to handle the work on a big scale. The point is, we find so far we are not able to get communities to continue to finance this malaria control so long as they are bothered with the mosquito pest. When we have county funds we shall then be ready to operate a strictly Anopheles control campaign. It appears to-day there is a rapidly growing sentiment for elimination of the mosquito pest, and the public is ready to-day to pay for mosquito control. There is a very small portion of the public ready to pay for Anopheles control. That is the situation. I hope the day is coming when we shall have you at another meeting, very soon, and be able to report otherwise.

Mr. MAGOON. This year we have used catfish control in about 400 cisterns and wells and Gambusia control in about one-fourth as many containers. I do not recommend catfish. The use of one or two catfish has no advantages and some disadvantages over the use of two or three pairs of Gambusia.

I believe it necessary to control mosquito breeding in open dug wells and cisterns in order to stop Anopheles breeding. I think mosquitoes would be found breeding in more open dug wells and cisterns if careful search were made for Anopheles larvæ.

Mr. LE PRINCE. The next paper is "Relations with outside engineering departments," by Mr. William Ropes.

RELATIONS WITH OUTSIDE ENGINEERING DEPARTMENTS.

WILLIAM ROPES,

Sanitary Engineer, International Health Board.

It has become almost an axiom with us that by far the greater number of mosquito-breeding places have been man made, but the courteous propounder of this truth delicately has refrained from telling us that many, very many of these are engineer made, and the worst of it is the engineer is making them still. As a class he needs education in the elements of malaria control as much as anyone else—more, for his opportunities for harm are much greater. It is our opportunity to educate engineers engaged in other lines of work and to secure their cooperation in malaria control. The particular branches of civil engineering which I have in mind are highway, railroad, drainage, and municipal engineering, their importance being generally in the order named.

It requires slight observation to see that the average engineer's ideas of drainage are entirely different from our own. A small amount of water, whether stagnant or running, is no menace to a road or railroad; in a big drainage ditch it is not considered at all. If a highway engineer finds it difficult to drain his ditches, he lets the water stay there or at best drains it away from the structure into a near-by borrow pit. Most highway projects have made little or no allowance for drainage, and the engineer in charge is simply obliged to do the best he can without exceeding his appropriation. Often he does not even seem to care; in fact, highway drainage is so generally neglected as to be a matter of comment in engineering publications. As I have mentioned, the highway engineer's ideas are quite different from ours, although they may be more costly, and I have not found that anyone has taken the trouble to instruct him in the elements of ditching as a malaria-control measure. There is an immense road building program under way throughout the country to-day and the responsibility of the public health engineer is as great to-day as it would have been during the great era of railroad building a generation and a half ago. It is a fact that in Arkansas alone it will cost many thousand dollars to undo the damage done along the new highways by the ignorance or carelessness of engineers, or those who pose as engineers. This is going on to-day in other States as well, and I for one have taken pains to make the acquaintance of highway engineers in order to call their attention to the trouble that lack of proper drainage is causing, and have given them all the copies I could find of Mr. Le Prince's pamphlet on Drainage as an Antimalarial Measure to set them on the right track. It is a pleasure to state that the Arkansas highway commissioner is now providing for proper malaria drainage in all new highway contracts.

As far as the railroad engineer goes there has been so little recent construction it may be said that the damage is already done; the railroads are built with their undrained borrow pits, the inadequate, badly graded ditches, insufficient waterways, and high culverts. With a realization of the present condition of the railroads, of their insufficient funds for maintenance, replacements, and drainage, it is our duty to give the railroad engineer or roadmaster all the assistance we can in order that his limited appropriations may be expended from our point of view to the best advantage. I believe that a railroad engineer has often a wrong idea as to the scale on which ditching should be done, and I know that even last summer there was much ditching that was not only defective in design, but the ditches were much larger than necessary. This occurred in towns where work was asked of the railroads, and as a result of this magnificent scale the extra crews were unable to complete the work in the time allowed. It is particularly desirable to propose such plans for cooperation before the malaria season opens. When we commence our work, railroad plans have already been made, funds apportioned, and all that can be obtained is the small amount that can be diverted from actual maintenance of way; whereas if the chief engineer were informed of our plans about the first of the year he would then be able to take them into consideration when submitting his estimates for necessary work for the coming year. I believe in this way we could get more substantial cooperation from the railroads, cooperation which is often very necessary.

The drainage engineer seldom does much harm. Cooperation with him lies more in making our plans fit his, though when he does do a real mosquito-breeding job, he does it thoroughly and on a large scale. Some levees I have seen—recently built, too—were fine examples of what ought not to be. In general the trouble with drainage works is lack of maintenance; ditches are blocked with drift and growing trees, so that in summer they are a series of mosquito-breeding pools. The engineer is hardly responsible, for no effort of his has yet been able to impress the necessity of maintenance on the inert official mind.

One class only remains, the municipal engineer, the man who will help keep up in the cities the work we have begun. We should inform him as to the kind of breeding places that are produced by bad design, carelessness, and neglect, and—if his funds are limited—which are the most dangerous and which he should attack first in municipal malaria work. The street-drainage question comes first in a small town; the waterworks in a large one.

In many towns in Arkansas intelligent street work will do away with from 50 per cent up to 90 per cent of even the Anopheles breeding places, not mentioning the numerous other mosquitoes. The water-supply system is a menace not because of the amount of water that leaks out, but because the leaks invariably breed Anopheles. I have found breeding in leaks from every part of a water system from the tank to the hydrant. In one instance a ditch a full half mile long was kept full of water and breeding Anopheles right through a town for two months by a leaky house connection. The town authorities were unaware of this leak until their attention was called to it. Leaky yard hydrants are a constant source of trouble, yet there are some designs that are nearly foolproof. We should indorse these. A fruitful source of annoyance is the familiar septic tank, yet it is just as easy to build a mosquito-proof structure over it as any, and oiling, if anything, adds to the efficiency of the septic tank. I have never found Anopheles breeding in a septic or Imhoff tank, but Culex breeds abundantly and I think it possible that Anopheles may breed in the effluent; in fact, I know they do in a septic tank effluent that is only diluted about 100 per cent with clear water. The street catch basin is a prolific breeder of several kinds of mosquitoes yet not many engineers know that recent practice discards them entirely.

The instances mentioned may be greatly multiplied and may be extended into other branches of engineering. Some of us are brought in contact with one class, some with another, and I am sure that if we are on the watch we will find opportunities in meeting these engineers to help and educate them and thus get better results, with the means at their disposal, in forwarding our own work.

Discussion.

Mr. Le Prince. The matter of screening that you brought to my attention—I want everybody to hear that.

Mr. Ropes. I happened to run across a novelty in screening this summer—at least it is new to me. There is a large girls' school at Searcy, Ark., having about 400 pupils, and screens were put on the windows and doors of the older dormitory about nine years ago. I do not know who conceived the idea, but these screens were of 16-mesh aluminum wire. These screens have been in place winter and summer for nine years, and so far as anyone can see they are just as good as the day they were put in. I don't know how aluminum would stand up in salt-water regions, but it seems to me it is worth trying anywhere; it must be just as cheap as bronze, which we have used so extensively.

Mr. Komp. I think I can beat Mr. Ropes's record by about two years. In Gulfport, Miss., on the Gulf of Mexico, one contractor whom I know very well tells me that he put screens on his house 11 years ago and hasn't touched them since, not even to paint them, and they are still in excellent condition. They are the Burrows Rustless screen, which I don't think is on the market any more.

Mr. Le Prince. We shall now consider the meeting adjourned until half past 1.

AFTERNOON SESSION, NOVEMBER 17, 1920.

Mr. Le Prince. We will have the next paper, "Financing an antimalaria campaign," by Mr. N. H. Old.

FINANCING AN ANTIMALARIA CAMPAIGN.

H. N. Old,
Assistant Sanitary Engineer, United States Public Health Service.

It should be understood that this paper, of necessity, refers only to urban, not to rural, work.

The first consideration in the subject of financing of a malaria campaign appears to me to be the budget.

Unfortunately the cost estimate or budget can not be framed in accordance with the size or resources of the community but must fit the local conditions of breeding. While the smallest possible budget may carry more appeal than a larger one, I have preferred to prepare estimates that I was sure would cover all costs, including emergencies of the campaign, at the same time stressing the point that absolutely no further appropriation would be requested later in the season on account of shortage of funds.

On this point I recall a remark made by a mayor of a small Georgia town last fall when the estimate was presented to the council. He was far above the average small-town mayor in business ability, and quickly asked my opinion as to how much in excess of that amount would be needed, for he said nearly all Government experts, to use his term, would estimate a certain amount for a job and find later that more was needed. There may be some truth in his version. At any rate I would rather lose a town than have to worry over finances in midsummer.

In this connection I will state that in the three Georgia towns worked this year there is an average of about 15 per cent of the budget remaining unexpended, and I find that this fact is having some weight, as a talking point, in continuing the work next year by making the financing problem lighter.

The next question is, From what source can this fund be raised? Usually there are only two possible methods of financing—by the municipal treasury or by public subscription, supplemented in some cases by aid from industrial concerns in or near the town. Often the condition of the municipal treasury is such that this source is out of the question, regardless of the attitude of the authorities; and I am frank to admit that in such cases I used to be discouraged, taking little stock in trying to finance a campaign by private subscription. But I am now a thorough convert to this method, for it possesses three very distinct advantages: First, educational; second, the entire elimination of politics; and third, the arousing of community interest and individual cooperation. When a person's cash pocket is invaded, he will usually read the campaign reports and publications with interest and will aid in getting the greatest return from his investment. Understand, I do not advocate that municipal malaria control be placed on a permanent public subscription basis, but for demonstration purposes for the first year, especially where the municipal funds are low, I favor it. However, after the first year it should be financed from the municipal treasury, as is the fire and police protection.

Protection from malaria must be sold to a community almost in the same manner that a commercial salesman sells his wares. The need must be shown, the practicability of control measures stated convincingly, and a strong appeal made to the appropriating bodies.

While it is seldom possible to ascertain during a hurried survey the figure which would represent the total financial loss in a town, the need must be shown in some manner on a dollar-and-cents basis—as an investment, in other words. Perhaps statistics previously obtained for a town with nearly identical conditions could be used in this connection.

As to the demonstration of the practicability of control measures, it should not be difficult to cite many instances of good results obtained in communities in which campaigns were conducted this year. The nearer such communities are to the town in question the more interest will naturally be shown.

With reference to the appeal, it might be well to relate here a rather amusing, but nevertheless typical, incident. Last fall Mr. Tiedeman, a former service engineer, and I visited a small town of about 400 inhabitants in south Georgia for the purpose of making a preliminary survey. After finally locating the mayor at his sawmill, we proceeded to explain the exact nature of our mission; but when asked as to health conditions in that section, particularly malaria, he evidently judged we were contemplating the establishment of a business there, as he very promptly replied that the town was one of the healthiest in the State, hardly knew what "chills and fever" was. Knowing this to be untrue we went into more detail as to the purpose of our visit, explaining that we were there to help the town eradicate malaria, even to render financial assistance if necessary. From that moment his whole attitude changed and inside of 20 minutes he declared the town was a deathtrap, and pointing over to the cemetery his memory took him back, to use his own words, "to many a time when one funeral coming up the road would meet another coming down the road at the cemetery gate."

Incidentally this official was a strong advocate of vertical drainage, as he told us that what that section needed was holes put down through the ground to drain off the water by connecting with those "submoravian channels."

However, his attitude was that of many who become suddenly alert when outside financial aid is in prospect. Therefore it is a great help to have even a small amount of State or other financial aid to use as a lever for getting work started.

Attention should be called to the class of individuals and organizations whose interest should be solicited in financing a campaign. At Thomasville, Ga., it was the commercial and civic organizations, the latter composed chiefly of women, that were influential in raising funds in that city. As the women will be taking considerably more interest in municipal affairs in the future than ever before, it is well to secure their interest and cooperation to the same extent that the interest of the bankers, manufacturers, and business men is solicited. It seems reasonable to expect that the nineteenth amendment will aid materially in financing campaigns of this kind in the future.

A close study of Mr. Fisher's article in the May 28 Public Health Report headed, "What can a community afford to pay to rid itself of malaria," will be very valuable in presenting the economic side of malaria eradication to a body of citizens.

In Georgia, this year, Albany, a town of 12,000 population, financed its own campaign entirely, appropriating $6,000, only about $4,500 of which will be spent, thanks to Gambusia.

Cairo, a town of about 1,900, appropriated $900 supplemented by $300 jointly from the State and the International Health Board. The estimate for an oiling campaign was $1,200, of which there will remain about $200 unexpended. This town could not possibly have afforded a campaign including proper drainage and requiring an expenditure of about $5,500. Therefore, rather than allow their interest to be lost, I outlined an inexpensive oiling campaign explaining that it could not be expected to be as effective as more thorough control measures. But I hoped to show some reduction, and had an entering wedge for securing a little better appropriation each year until the necessary drainage was completed. I would strongly advise anyone contemplating a curtailed campaign of this kind to make provision for a full-time inspector, except under unusually favorable circumstances. At Cairo the chief of police was placed in charge locally as inspector, but devoted very little time to the work. However, while it is too early to give definite figures, I find from doctors' statements that there has been a very satisfactory reduction in the prevalence of malaria as well as of mosquitoes, on the strength of which I believe my estimate of $1,800 can be secured for next season.

At Thomasville the city was deeply in debt and did not provide a cent toward the budget, which was raised chiefly by private subscription. The county commissioners appropriated $1,500, while $3,500 more was raised by the activity of the local health officer and the manager of the commercial association, who were inspired by Mr. Le Prince's talk at a citizens' meeting. It was possible to arouse very little interest in the meetings held, judging by attendance, but the prospective contributors were hammered with letters and phone calls until the goal was reached. Despite the fact that the fund was not collected until June 1, necessitating a late start, the public sentiment at Thomasville appears to indicate that very good results have been obtained. The fall malaria census now being taken, I believe, will confirm this.

In conclusion, after a field man goes to the limit of his ability to put a proposition across and is still skeptical of success, I would draw special attention to a remark made by Mr. Van Hovenberg at the last conference which sums up my experience entirely in financing malaria campaigns. The remark to which I refer is, "If you are making no headway, I would advise telegraphing for Mr. Le Prince."

DISCUSSION.

Mr. LE PRINCE. The subject is now open for discussion, but I wish to state the subject is not only financing an antimalaria campaign but also includes the question of approach.

Mr. Carter will open this discussion.

Mr. CARTER. Mr. Chairman, I found in raising funds for the work in the towns that the various clubs, especially those in which the women are interested, were a great help.

It has been my experience that on approaching a town for the purpose of raising funds for an antimalaria campaign it is a good idea to meet and talk to some of the prominent business men, get them interested in the work, and request their presence at the meeting at which your proposition will be put before the town council.

In one town which I worked last year, I found the council opposed to any measure requiring an appropriation. After talking informally with the members of the council, I interviewed several prominent citizens and had them attend the council meeting when I asked for the necessary funds. Two or three of these citizens arose and demanded that the appropriation be made. Under this pressure the council appropriated the amount we had asked for. Had I not had the active support of these few citizens, I am sure the council would have refused to make the appropriation.

As I say, the various organizations, such as the chambers of commerce, civic association, Rotary Clubs, and women's club, are, I think, the mediums through which we should work, and by so doing obtain very satisfactory results.

Mr. Le Prince. I want to ask you, Mr. Carter, supposing you had a new man coming on to this work and you were advising him regarding the general situation, just what would you tell him to do?

Mr. Carter. Mr. Chairman, that is a rather difficult question. I don't think any definite method of procedure can be outlined which will suit each community. I would say, however, I consider it a very good plan to spend a few days in a town meeting and sizing up the people before putting the proposition up to them for final disposal.

In most towns of the size in which we put on campaigns, there are almost invariably one or two citizens who dominate the town. The question is to find them, cultivate them, and secure their confidence and assistance. Call on the bankers, lawyers, doctors, and merchants and explain to them just what you expect to accomplish with the campaign. After you have once won over to your side this class of citizenship, should the council not be favorably inclined, they are very apt to reverse their opinions and get on the same side with the leading citizenship.

Mr. Le Prince. I expected that when this subject came up you would all stand up at once. Now, I am going to be perfectly frank about things.

The first years that I was doing this sort of work I was a very successful failure, and I think we ought to talk a little of those failures as well as our successes, for the benefit of those who follow us. I am going to call upon Mr. Fuchs to talk along the line of the difficulties that a man runs into when he starts.

Mr. Fuchs. The matter of an appropriation for malaria control was brought up before the council of a certain town and representatives of the chamber of commerce and the women's club were present. Everybody seemed to be enthusiastic about it. One of the men on the city council who opposed the appropriation attempted by a clever maneuver, to table the proposition indefinitely by proposing the appointment of an investigating committee. That is the thing to be guarded against. Don't permit leaving the question to an investigating committee that may never report. I insisted upon having the matter thrashed out right there and then. I think the insistence on my part and on the part of the representatives of the chamber of commerce, that the matter be not tabled, but that it be decided without delay, saved the day, and they all voted in favor of it.

Mr. Le Prince. In recalling records of success I remember that several of us had the same difficulty I had; they learned how to succeed by failing, and I think you are all getting more expert than you used to be.

I admit frankly that I didn't know how to approach a community when I first had to do so. I am going to call on several to touch upon this subject; first, Mr. Johnson.

Mr. Johnson. I haven't had very much experience along that line, but I think that the most important thing is to get the doctors on your side.

Now, I fell down badly in getting three or four towns because I had opposition among the doctors. I find that when I have one or two doctors against me in a community I have not got a chance. The first thing I do in a town, before I make a survey, is to go in and see those doctors and get them together and talk the matter over with them, and since I adopted that policy I have been able to get along very well.

Mr. Le Prince. That is a very important point. I have made one big error. I once found so much encouragement at the chamber of commerce that I omitted to extend the proper amount of courtesy to the mayor of the town, and an unusual amount of care should have been taken, because the mayor of the town and the chamber of commerce were at odds, and I didn't know it until later.

Mr. Shaw. Referring to Mr. Johnson's remarks, I should think the engineer would be at a great disadvantage in most communities if he failed to present this matter to the city officials first. There are certain types of individuals in the persons of the mayor and health officer who wish to receive credit for initiating all municipal activities. In such cases should one present the matter to the doctors first, he will later meet with antagonism from the officials because they feel that their opinion has not been considered of first importance. I believe in bringing this matter to the attention of the mayor and then getting in touch with the business men and doctors, and if sufficient interest is shown, prepare the estimate and bring the matter up for final decision.

Mr. Le Prince. You heard yesterday Dr. Hayne's views of the matter of per capita cost. There are times in certain portions of certain States when it is advisable to take up a relatively expensive problem in order to get the desired public approval.

A very important project of this nature has recently been taken up and we would like to hear from the State sanitary engineer, Mr. Simons, in regard to it.

MALARIA-CONTROL DRAINAGE PROJECT, PERRY, FLA.

GEORGE W. SIMONS, JR.

Chief Sanitary Engineer, Florida State Board of Health.

At Perry, in Taylor County, Fla., the Florida State Board of Health in cooperation with the United States Public Health Service is executing its first intensive antimalaria campaign, one which measured by its magnitude, the variety and extent of control measures undertaken eclipses many such projects already completed in the South. The Perry project is undoubtedly one of the largest yet undertaken. The program now being followed at Perry includes practically every known means of combating the mosquito and bringing about its control, namely, (*a*) oiling, (*b*) fish control, (*c*) screening, (*d*) quinine prophylaxis, and finally (*e*) drainage. Of the latter work this article will deal mainly.

Perry is located in the center of a vast long-leaf pine timberland, about 115 miles west of Jacksonville and about 20 miles from the Gulf of Mexico. It is the county seat of Taylor County, a town of about 2,200 people, having as its principal industry the large mills of the Burton-Swartz Cypress Co. Within a few miles of Perry are located several other large mills of various corporations. The town is virtually the main center of trading and transportation for the surrounding lumber industry.

Topographically Taylor County is flat. At Perry and thence to the Gulf the average surface elevation does not much exceed 30 feet above sea level. The land is typical of piney woods and cypress swamp, the latter becoming more in evidence as one nears the Gulf. The superficial soil consists of a fine porous sand underlaid with a heavy blue clay and saturated sand. Near Perry, in spots, a porous lime rock is near the surface and along some streams lies exposed. Lime sink holes with disappearing streams and bubbling springs are to be observed in many places.

The standardized Vital Records of the Bureau of Vital Statistics of the State Board of Health indicate that during the year of 1918 Perry and Taylor County experienced high mortality rates from malaria, rates of 405 and 147 per 100,000, respectively. A comparative study of malaria incidence at other points in the State readily convinced the authorities that a project encouraged and carried to completion at Perry would result in an untold good among the inhabitants and to the lumber industries, also serve as a typical demonstration to the remainder of the State. Accordingly, during January, 1920, a preliminary investigation was instituted to ascertain the actual prevalence of malaria among the people, its effect upon the industries of the community, the attitude of the community toward malaria control and their readiness to assist in an undertaking.

The preliminary survey revealed a number of very interesting facts: (1) the whole community was intensely interested in any project which would relieve the malaria incidence; (2) the morale of the community was low as a result of malaria prevalence in previous years; (3) the local industries were vitally interested in any measures to reduce the malaria incidence and improve general health conditions among employees; and (4) enough patent medicines and febrifuges were annually purchased by people of the community the wholesale cost of which would almost defray the cost of a drainage project.

The residents of the community were alert to the needs and presented themselves as eager and ready to attack any task that could be outlined to them. Malaria had been assumed by many as a matter of course, and many there were who reckoned time by " the last chill." A house-to-house survey during January, 1920, indicated that during 1919 about 65 per cent of the people had malaria or " chills and fever," also that during the same period the wholesale cost of febrifuges sold by drug stores and other places totaled or approximated $11,000. Following are tabulated the results of interviews at 218 Perry homes, relating to 1919 malaria conditions:

Number of families or houses interviewed	218
Number of people in houses	975
Number of malaria cases in last 12 months	632
Per cent of people having malaria	64.8
Number sick with malaria at time of interview	88
Per cent sick with malaria at time of interview	9
Deaths from malaria	3
Number of houses not screened	79
Number of houses not effectively screened	65
Number of houses effectively screened	74

Following the preliminary survey the facts were laid before the local town officials and a representative of the principal lumber industry, who readily saw the wisdom of a plan whereby the malaria incidence of the community might be reduced, the general health conditions improved, and labor conditions bettered. The town of Perry, with a civic consciousness believing in its future, immediately voted the sum of $15,000 toward the initiation of a drainage project, and the Burton-Swartz Cypress Co. added $10,000 to assist. At the time of the preliminary survey it was estimated by engineers that necessary drainage measures would consume approximately $30,000.

The town of Perry lies between the forks of two meandering streams—Spring Creek on the south and Pimple Creek on the north.

These streams unite at a point near the east city limits and the Burton-Swartz mill property line to form the main channel of Spring Creek, which flows into Rock Creek and thence into the Gulf of Mexico. The Spring Creek channel flowing through the town limits is a small meandering stream having a wide, flat, and shallow valley or stream bed on either side which during times of high water is overflowed. Pimple Creek is a smaller, less meandering stream, and at one point in its course enters a lime sink hole into the ground.

At a point on Spring Creek there occurs a natural sink or "boil" from which a great quantity of water issues daily giving rise to a steady consistent flow through the channel line. Another sink formation is to be found at a point midway between the "boil" and the stream junction. Because of the several sink-hole "boils" and the disappearing stream formations in this locality it was very difficult to ascertain a well-defined drainage area for run-off computations in the drainage works design. A number of miles to the north of Perry what is locally known as San Pedro's "bay" is encountered. Once or twice per year this extensive semiswamp area, closely resembling cypress ponds, discharges water into the two stream forks. The quantity is sufficient to flood all the adjacent lands. About June 10th of this summer such a flood was experienced in Perry.

The preliminary engineering survey at Perry indicated early the feasibility of utilizing the two existing stream forks and the main channel as a basis for a more comprehensive drainage system. It was considered that a deepening, straightening, and widening of the existing channels would assist greatly in lowering the present water table, quicken the velocity of flow, eliminate the many bends, and hasten the surface water removal. The channels would also furnish an outlet for a future system of pipe drainage from isolated sinks and low depressions. In accordance, later surveys and studies were made along these lines, the project designed and contract let.

The final plans as being executed at Perry consist mainly of stream rectification work. The existing stream valleys are being used as a basis but only in long straight stretches are old channels being used and then only after a deepening and widening. All ditches have side slopes of 1 to 1 and the average cut throughout the ditches is about 6 feet. Following are given some of the original design elements:

Length of ditch.	Bottom width.	Grade per mile (about).	Velocity with 5 feet depth (per second).
	Feet.	*Feet.*	*Feet.*
4,300	8	2	2.2
3,400	7	2	2.2
9,000	4	3	2.3
5,000	3	4	2.6

As the work progresses some of the above elements may be altered to better fit the funds at hand, but generally speaking, the above are correct.

The estimated excavation will amount to about 47,000 cubic yards, about 20,000 of which will be handwork, the remainder machine work.

As stated previously, it was difficult to ascertain a well-defined drainage area for the purpose of run-off computation work, because of the presence of so many limestone sink holes and "boils"; then again the exact nature and action of San Pedro "bay" was not well known. Inasmuch as the entire project was for surface water removal mainly and not for agricultural purposes, an arbitrary drainage area amounting to approximately 3,500 acres was assumed. A run-off of 1 inch per 24 hours was also assumed, and upon such basis the channels were designed.

The actual construction work was commenced by the contractor on June 24, and already much of the eight-foot bottom section is completed. In the course of construction considerable running, or heavily saturated sand, was encountered. This will be removed either by suction pumping or dynamite. Overlying the sand much heavy, sticky, blue clay was handled.

The remote location of the work, the scarcity of local labor supply, the extent or size of the job, and its emergency nature precluded the placement on the job of the best and most ideal equipment obtainable. Ideal equipment was largely occupied on larger works elsewhere or their owners would not consider bringing it into the district for such a small job. Consequently the machine now working is not the best suited nor the most economical, but at the same time is of a type which is progressing slowly and doing a neat work. Had more time been available for the selection of equipment a more suitable machine could undoubtedly have been secured, but experience in the large southern drainage districts indicates that oftentimes the most ideal equipment can not be readily put to work.

The entire contract will total about $31,000, which for the community amounts to nearly $16 per capita.

In addition to the open channels a number of small pipe lines will be laid from remote sinks or depressions to the channels; also from low-lying properties bordering the stream valleys. This latter work will for the most part be done under a local city ordinance empowering the authorities to request property owners to drain any areas specified.

During the summer months while the ditch construction was progressing slowly, oiling, screening, quinine prophylaxis and fish-control measures were enforced to control mosquito prevalence. As a result of these several activities malaria incidence, and also mosquito incidence, were greatly and perceptibly reduced.

Comments from many citizens and members of the medical profession at Perry tend to indicate that there has been a decided bettering of conditions this past summer. Of course improvement is probably due to many factors, but the above named play an important part. Several doctors claim malaria has been "a scarce article" in Perry this season; other citizens claim this is the first time they have been able to sit on their verandas in years. One professional man informed the writer that after a few years in Perry he was becoming discouraged and was about to sell out and leave, but the summer's activities, combined with prospects for good drainage, gave him courage to stay, and instead of disposing of his property was going to invest in more property and boost. One fraternal organization that previously rented quarters devoted one night to prospects and their future. After a long deliberation it was decided, in view of the drainage measures undertaken, to invest and build a three-story structure. Such incidents are common and encouraging in their tone.

Drainage measures were under the supervision of Asst. Sanitary Engineer J. G. Foster, U. S. Public Health Service. The prophylaxis, oiling, general conditions, and much of the residential screening were under the direct supervision of and executed by Dr. A. C. Hamblin, district health officer, of the State board of health, who was assigned to duty at Perry. Approximately $1,000 worth of quinine was distributed by the State board of health during the summer months. Solar oil of the Gulf Refining Co. was used in oiling ponds, pools, ditches, and streams.

Early in the year the city council at Perry promulgated a screening ordinance requiring all residents to screen windows and doors. During the summer months inspectors of the bureau of engineering of the State board of health were active in enforcing the order in cooperation with the Perry marshal. The results have been very successful, and to-day at least 90 per cent of all homes are screened thoroughly. It is an encouraging sight to pass through a section of colored huts and see all openings screened and tightened up. In addition to house screening the State screening law was enforced at all groceries, markets, drug stores, fruit stands, or other places where foods and drinks are offered for sale.

Sanitary inspectors of the bureau of engineering were active in Perry all summer doing general sanitation and clean-up work. Rubbish and refuse of all description were frequently removed, and since August 15 sanitary privy construction has been under way. Up to November 1 no less than 150 new sanitary pit privies dot the town, another inspiring sight.

Under Dr. Hamblin's supervision much hookworm and trachoma work has been done, work worthy of great commendation.

The drainage measures now under way will be completed about April 1.

Mr. Le Prince. I think the State Health Department of Florida has done correctly, and I don't doubt but what after this work is done their future problem will be to find enough trained men to take care of the applications for malaria control that come to the State health department. I think it is a splendid beginning to select a place that is so unusually malarious.

Mr. Simons. I might say that since we started, the nature of the work has got around the State until we have now applications for four additional projects, and they are all of them larger than this one.

Mr. Le Prince. The next paper will be "Subsoil drainage," by Mr. J. G. Foster.

SUBSOIL DRAINAGE.

J. G. FOSTER,

Assistant Sanitary Engineer, United States Public Health Service.

Very much of the work of ditching, channeling, and pipe or tile drainage with which we have to deal is along or near previously existing natural or man-made watercourses. In most of our work main drainage systems are generally as nature provided them, with small alteration by man. Usually they need cleaning and training throughout their entire length. Their constrictions, where bridges, culverts, and other passageways over them occur, are of great interest in malaria control operations.

Structures providing artificial waterways should be of such design that drift will not lodge in them, and of such cross section that large scouring action will be avoided at the effluent end of the structure. Sometimes slight constrictions are of value, as the increased velocity induced by them will remove small trash which might otherwise provide breeding places for Anopheles.

We should provide for adverse conditions, such as occur at low water and at flood flow. If there can be choice of two designs in planning bridges or culverts, the simpler device with one wide opening is to be preferred. Sometimes lack of headroom makes it necessary to lay pipe or make culverts in several small units, where one waterway of larger vertical dimension would suffice. The single outlet of large diameter is preferable, even though it might be slightly inadequate at flood flows. Where more than one culvert must be installed, due to the lack of headroom, if possible one culvert should be set lower than the others, which should have their inverts at least above the level of ordinary flow. This construction is preferable, even though more lines of pipes be required to care for flood flow. The deepest culvert may have a minimum allowable gradient, since it is presumed always to carry some flow. The other lines of culverts may well be on steeper grades, but no part of their bores should be below the ordinary water surface at their lower ends.

These flood flow lines should be laid to a grade in a vertical curve tangent to the horizontal at the influent end. This will allow for some subsidence of culverts under embankments and under heavy traffic without forming pockets in which water might collect.

Probably this device of staging the levels of multiple culvert installations should be employed only where as much as 10 inches vertical difference in stage may be had; otherwise an oil film could not enter the upper conduits.

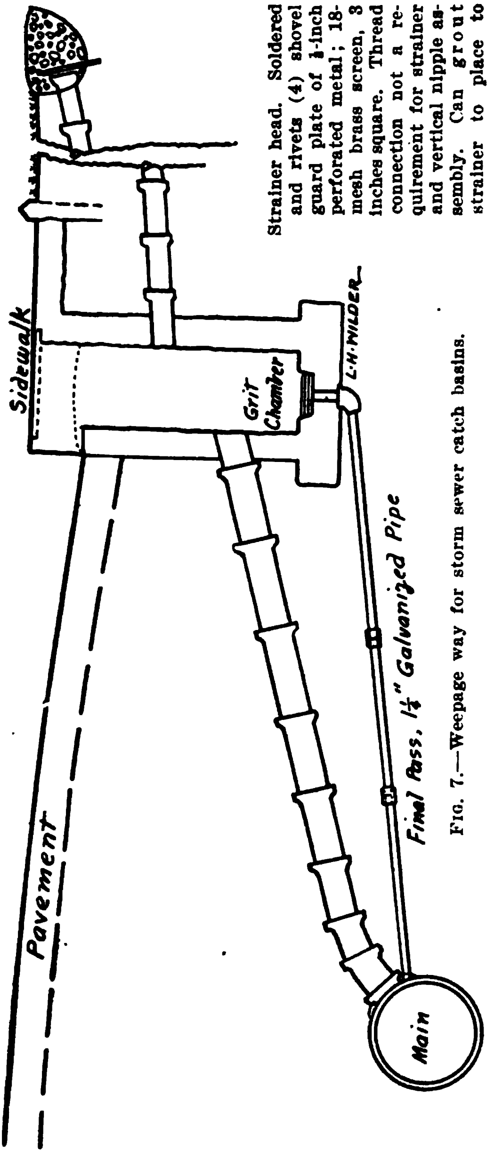
Sometimes advantage may be taken of the free oiling provided by utilizing waste obtained from garages and machine shops. If such wastes are conducted directly into sanitary sewers they are lost for our purposes, but if they go directly into storm sewers the oil is sometimes very effective in preventing breeding along the course of the outlet stream.

In urban communities, where considerable street paving has been done, there is usually a separate sewer system to carry off storm water. Catch basins for the storm sewers usually are placed from 100 to 300 feet apart, and are provided with a grating or curb box at the intake. Grit chambers or sand traps are placed at the bottom of the catch basins, with the bottom of the grit chamber from 8 to 15 inches below the invert of the pipe leading to the storm sewer. These grit chambers generally hold water long enough to propagate mosquitoes, and due to the admixture of organic street refuse with the retained water, usually breed them prolifically. However, only a small percentage of mosquitoes breeding in catch basins are Anopheles. It is not practicable to screen curb or grate inlets for storm sewers. Sags and inequalities in grade or ponding of water by accumulation of drift and sand within the sewer pipes themselves serve as breeding places. This type of breeding place is usually best controlled by oiling, although periodic flushing of the entire system, either by rains or by water under pressure from the city mains, will be of great aid. The breeding in catch basins is sufficient to maintain a small supply of mosquitoes throughout the season, which serve to keep seeded large areas, which otherwise might be entirely free.

An attempt should be made to have all future storm sewerage so constructed that a weepage way is provided from the bottoms of grit chambers to the sewer main. This might be a 1¼-inch galvanized-iron pipe, equipped with an upturned entrance and a brass strainer, and a perforated sheet-metal shovel guard about 3 inches square, set in a recess in the bottom of the chamber. The slope in the galvanized pipe would need to be very slight in order to completely drain the grit chamber before breeding could occur. This method is dependent on the slope limits.

Catch basins in many instances are the chief source of mosquitoes in urban areas. They are dangerous because they provide water charged with organic matter, such as horse manure, in an environment with modified light and equable temperature. Their danger lies particularly in their nearness to an abundant blood supply, with consequent opportunity for prolific egg laying.

Lot owners should not be permitted to construct any sort of grit chamber on their premises. All detritus from earth washings can be caught in the curb sand trap or grit chamber. Attention should be called forcibly to the dangers in storm sewer catch basins as sources of mosquito breeding, as otherwise the local authorities may neglect them in future years, to the great detriment of our work.



Strainer head. Soldered and rivets (4) shovel guard plate of ⅛-inch perforated metal; 18-mesh brass screen, 3 inches square. Thread connection not a requirement for strainer and vertical nipple assembly. Can grout strainer to place to better advantage.

FIG. 7.—Weepage way for storm sewer catch basins.

In the outlying suburban areas of a town there will usually be found an extensive open-ditch drainage system, provided by the property owners to a large extent, but often installed by the public authorities to provide an outlet for the town's drainage. These are usually neglected after their construction, and almost invariably are in need of considerable work to place them in serviceable condition. Such ditches are usually from 1 to 5 feet deep, and from 2 to 3½ feet wide at bottom. Their side slopes are frequently of the so-called "natural" appearance; i. e., to an observer standing in the ditch the upper half of the slope is somewhat convex, while the lower half is concave. The spoil banks on the sides of the ditches are usually continuous, and no waterways are provided through them, with resultant impounding of water along the banks. In order to obtain grade, the ditches are dug deeper at the lower or outfall ends, and the resulting greater amount of spoil is not distributed evenly, but piled higher along the edge of the banks, causing caving and obstructions in the stream bed. Water grasses and algæ further make trouble by destroying the continuity of an oil film when oil is used to control breeding. Frequently the ditches forming the outlying drainage system of a town hold water all year round, and sometimes they breed so many mosquitoes that man's work in making them has provided a more favorable breeding ground than the original ponds and pools, which would have been extensive only during a part of the season. Such ditch work can be made temporarily safe by clearing and oiling.

When the permanency of the work is to be considered, it may often be feasible to employ a combination of open-ditch and tile drainage. Thus, large ditches may carry off the excess flows, while lines of tile laid in the bottoms of these ditches may care for the water that otherwise might lie in depressions along their courses. The cost of installing such tile should not be very great, as the amount of earth to be excavated will seldom be greater than the displacement of the tile. Conditions are favorable for this sort of work if the tile drains can be emptied into a deeper natural channel or ditch. Where no difference of level occurs, it will be necessary to go below the termination of the tile drain, and lower the bottom of the ditch to provide an outlet for the tile. At such outlets there should be a riprap flooring to prevent flood flow from soon equalizing the bottom slope and disturbing the pipe outlet. One-third of a cubic yard of brickbats will make a satisfactory barrier, usually. Brush and stakes can be employed with good results for the purpose, if better material is lacking.

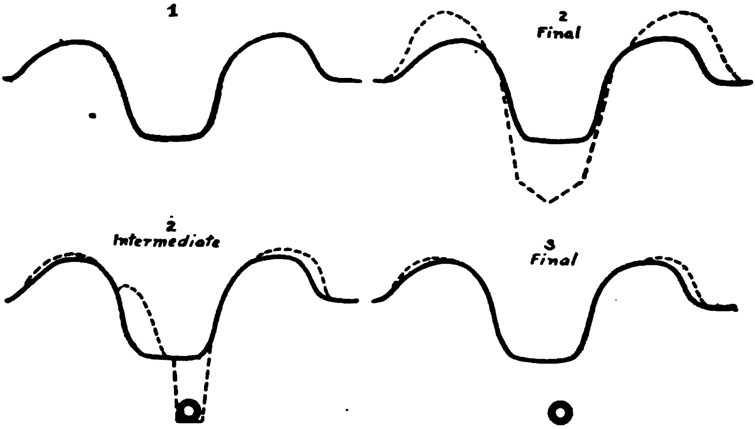


FIG. 8.—Showing elective methods for ditch improvement.

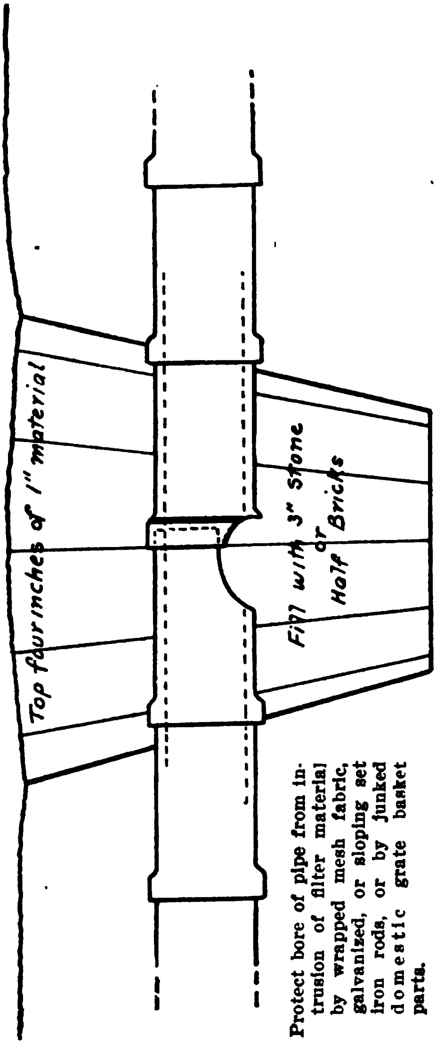
Pipes of bell and spigot design are preferable for this sort of work, even for as small diameters as 4 inches. In buying pipes, economy may be effected by taking what are termed "seconds," as for conformation, i. e., slightly "out of round," not quite straight, or with cracks through bell or spigot, provided they be "season" cracks, made before the tile is burned. No pipes with cracks formed after burning should be accepted. Hard burning of all pipes must be a positive requirement. Such pipes will afford a durable job, and will cost from 30 to 50 per cent less than standard sewer pipes, which are rightly required to be of nice form in all respects in order that joints made in sewer lines may be as tight as practicable. In our work we wish to admit as much water as possible to the pipe; but sewer designers wish to exclude all ground water. Pipe lines will usually be laid "dry," cement joints being rarely employed. In clay ground and in loams, pipes should be laid with ends up tightly, but with no joint materials whatever. In free-running sand, oakum, or waste cotton or rags are useful as a joint-making material; if near at hand a crude asbestos supply would be preferable if not too costly. On most jobs not 15 per cent of pipe work will need any sort of joint packing. After pipes are laid it is well to place vines, brush, and trash over the joints of the tile before back-filling.

As a general rule all trees within 30 feet of a tile line should be killed. Oaks and pines are not apt to make trouble, but roots of elms, hackberry, and other allied trees are sure to clog the entire bore of the pipe after a few years.

Where only small pipe is required in clay ground, 3 or 4 inch ordinary farm drain tile may be used. They should be laid at a depth of not less than 1 foot, as otherwise hogs or cattle may disturb them. Work done with such plain tile is much improved by wrapping the joints with cheap one-ply tar roofing paper in 3-inch wide strips. Where a pipe line is to be covered with not more than 8 inches of soil, it should certainly be of bell and spigot pipe. No direct openings should occur in drain pipe lines, and where large amounts of water must gain access to the tile, rough filters, such as will readily pass water but stop trash and vermin, should be constructed. Such a filter may be made by excavating a chamber beneath the grade of the pipe to a depth of twice the bore diameter. This chamber should be circular, with a diameter at least three times that of the pipe. This chamber should be filled to the grade of the pipe with 3-inch broken stone or brickbats. Then choose a pipe from which about one-third of the bell has been accidentally broken, and another pipe which has lost a part of its spigot, and scallop away what would be a semiellipse if it were flattened out, so that about one-quarter of the pipe circumference is taken away at the spigot. The length of the scallop back from the spigot should be about three-quarters of the interior diameter of the pipe. Assemble the two pipes in such a manner that the resulting opening faces downward on the filter substructure already prepared. Use a few small iron rods placed nearly vertically, or some galvanized mesh fencing, to prevent filter material from getting into the pipe line, then continue the filter up to the ground surface, expanding it as it rises to an effective diameter at the top of four to five times that of the pipe. A filter such as is described which serves as the outlet at the sump of a pond should be heaped up well above the surface of the ground to prevent interference by ploughs and vehicles. Filters on pipe lines in street-side ditches should be built at about 50-yard intervals, and should be graded to half-inch material at the top, to prevent boys from throwing it away.

The cobble-filled trench or "French" drain, as the texts of 20 years ago termed it, and the three green poles with vines and grass overcoat, the whole covered with soil, are devices of merit, and should not be overlooked even in this day of factory-made devices.

A very high authority states in his paper entitled "The Malaria Problem of the South" (Bureau Reprint No. 552): "I count drainage, especially tile drainage, the key to the rural malaria problem." A very trenchant remark it is, and the writer is grateful to be able to quote it in closing this paper.


Top four inches of 1" material
Fill with 3" Stone or Half Bricks

Protect bore of pipe from intrusion of filter material by wrapped mesh fabric, galvanized, or sloping set iron rods, or by junked domestic grate basket parts.

FIG. 9.—Rough filter for use in drainage operations.

DISCUSSION.

Mr. LE PRINCE. Gentlemen, to open this discussion, I wish to ask Mr. Foster if he will kindly supply us at a later date with a copy of this diagram so that it can also be put into the record, and I wish to call your attention to some of his work done at Fayetteville, N. C.

Mr. Fuchs. Mr. Chairman, the subject of street catch basins is one, I think, that has been a thorn in the side of every man who has had urban mosquito work to do. But while I should like to see Mr. Foster's plan work, I am afraid that the natural street sweepings or washings will in a very short time clog the strainer at the small outlet to the lower pipe that he proposes, so that it will not be effective.

I should like Mr. Foster to state whether he has taken that possibility into consideration.

Mr. Le Prince. Any further discussion?

Mr. Clarke. At Coffeeville, Miss., I laid about 1,000 feet of 5-inch farm tile drain. It was put about 18 inches below the bottom of large street ditches, which had been constructed wider than necessary in order to get the required grade, and the street ditches were filled to form ordinary sized gutter ditches. This not only removed standing water, but improved the appearance of the street.

Mr. Le Prince. Any further discussion? I will ask Mr. Foster to close.

Mr. Foster. Mr. Fuchs asked a question as to the clogging of the strainer that I talked about. I know that that is a matter for the future to solve; we will have that trouble continuously. I confess that I don't know that that is the best method at all. I don't know how much space should be given to the making of the strainer head which should be put on the contrivance. It wasn't expected it would unwater the basin in an hour; if it would unwater it in three or four or five days we would be very well satisfied, and I advanced it simply for consideration. I would be glad to see some one carry it further.

I wish to state that a good bit of tile drainage is being employed on the Perry project to drain ponds in back of some rather high spoil banks, which in a great many places will have to be continuous. These lines will be only 100 to 200 feet long, and will be equipped with filters at the inlet end.

Mr. Le Prince. The next paper will be "Propaganda for selected towns," by Mr. L. G. Hastings.

PROPAGANDA FOR SELECTED TOWNS IN CONNECTION WITH THE DEVELOPMENT OF ANTIMALARIA CAMPAIGNS.

L. G. Hastings,

Sanitary Engineer, International Health Board.

The successful development of an antimalaria campaign depends upon the interest that can be aroused in the citizens in general. For this reason it is very essential that such propaganda be disseminated and such a slogan developed as will awaken the people to an active interest in the malaria situation. To do this, it is necessary to become acquainted with members of local organizations, such as city councils, chambers of commerce, Rotary Clubs, women's leagues, labor unions or councils, large business enterprises, and the prominent citizens of the town. Through these organizations the public may be educated regarding the contemplated sanitary movement. We can not expect the hearty cooperation of any people until we have acquainted them thoroughly with the public health movement we are about to launch.

Upon entering a community for the purpose of developing an antimalaria campaign the first step should be to get in touch with the mayor, and get his attitude on the subject. If it is favorable, use it to support the campaign; if unfavorable, he should be educated first. After you have become acquainted with the mayor and other city officials request that one of them take you to see each of the local physicians, and from them secure all data available relative to the prevalence of the disease. State the purpose of the survey and arouse their interest and sense of duty.

Next arrange for meetings of the local organizations such as the chamber of commerce. It is essential that a notice of these meetings appear in the local newspapers to insure a large attendance. It is probable that you will have an enormous crowd, especially if the people are continuously molested with the mosquito pest. Such occurrences are very common in most of the towns of Arkansas. During your interviews with such organizations discuss the exact nature of the contemplated campaign. Explain the results they may expect after the first season's control measures, and lay particular emphasis on the small expense of the control measures. It is not necessary to go beyond certain limits with this cost discussion, as it will be presented when the final report is made. If you have any letters of indorsement or commendation from officials of other towns where you have carried on successful control measures, they will prove very valuable if read to your audience. Letters of this nature from mayors or health officers of such towns carry more weight than if written by others.

After you have addressed the local organizations, see the principals of the graded and high schools, explain to them the details of the malaria campaign and the necessity of educating the citizens in this direction. Have them talk malaria and mosquito control to their students, and request that they make this study a part of their curriculum in connection with the science courses. Such instruction to the children is valuable, for they will carry their new learning home and will do considerable toward the eradication of breeding on private premises. The instructors should be supplied with Carter's Malaria Primers and other literature which may prove helpful. The Arkansas State Board of Health is supplying certain leaflets on malaria to be pasted in school textbooks. This leaflet is quite elementary, but contains fundamental facts relative to the cause and prevention of malaria, and seems to be very well designed for pupils of the primary grades. If possible give an illustrated lecture on malaria and mosquitoes to the students, but guard against the use of too many scientific terms. The pupils will be attentive provided they know just what you are getting at.

It is often desirable to interest the influential ladies of the town in the malaria problem. Their aid is valuable when the time comes to launch the campaign. The ministers of the town are usually glad to mention public-health activities from their pulpits; they are also influential in their community. On several occasions I have been interviewed by certain district insurance agents who were able to talk malaria intelligently. They are interested in the malaria situation and often offer considerable assistance by having their local agents distribute malaria literature to the people free of cost. It is very desirable to secure the support of these men and it is possible that they may make a malaria census for us later.

Another method which is very effective is the presentation of malaria slides at intervals on the screens of movie theaters. It is suggested that some provision be made for securing a supply of slides for this purpose like those used for hookworm, tuberculosis, venereal diseases, etc. Have the local health officer or other qualified person present a brief outline of the malaria situation and the contemplated work just before the slides are shown. This idea was furnished me by one of the citizens of Prescott, Ark., while in that city for the purpose of making a preliminary survey. Brief articles on malaria appearing in the newspapers are effective. By this method we are able to reach the people who were unable to attend the lectures. If possible have the city health department print malaria dodgers to be distributed throughout the town. These should be very plain in order that they may be understood by all classes of people. In Fordyce, Ark., a sign painter preparing advertisements was requested to preserve one section of his billboard for these words: "A successful antimalaria campaign is being conducted in Fordyce." It appears to me that such an advertisement will be a boost for the town and would be to a certain degree instrumental in causing the town people to see that the work did not fall through once control measures have been inaugurated.

DISCUSSION.

Mr. LE PRINCE. The subject is open for discussion. I think the question that was brought up regarding the importance of propaganda being used in the towns in advance is a matter deserving our consideration.

Mr. LENERT. Only a portion of the State of Texas is within the district in which malaria is endemic. This naturally gives rise to an argument between the western part of the State and the eastern portion on such questions as the location of State institutions. The Agricultural and Mechanical College is located at Bryan, one of the points at which Mr. Hardenburg carried on a demonstration during the past season. When the campaign was started in the spring the citizens of Bryan generally objected to calling it an antimalaria campaign, being afraid that it might give ground for an argument against Bryan as a pesthole for malaria. The campaign therefore lost one of its strongest talking points and it was necessary to consider it principally from the nuisance standpoint.

Mr. LE PRINCE.—The next subject on the program is "Tide-gate operations at Savannah," by Mr. Davis.

TIDE-GATE OPERATIONS AT SAVANNAH, GA.

W. A. DAVIS,
Special Expert, United States Public Health Service.

Savannah is located on the Savannah River at a point about 18 miles from its mouth, at which point there is a normal tidal rise of about 7 feet. The elevation of the city at a point about 100 yards from the river is about 45 feet above mean sea level. Running south there is a gradual slope until an elevation of about 8 feet above mean sea level is reached. On the east and west sides of the city are the low rice-field lands. These fields, long abandoned for rice culture, are from 3 to 4 feet below mean high tide and in their natural state are subject to overflow from the tidal variations in the river. In addition to the tidewater which covers this area, extensive drainage canals from the swamps of the county pass through these lands. The tremendous volume of water accumulated in the swamps during the rainy season, added to the natural overflow of the tidewater when these lands are undrained, creates conditions that makes tide-gate control imperative. A combination of methods was adopted for the control of these fields and canals.

As early as 1817 the citizens of Savannah realized that these low rice-field lands, in an inundated condition, were a menace to the health of the people living in Savannah and especially those living in the areas adjoining them. This is evidenced by the following extracts taken from an article, The History of Dry Culture, written and published in 1826 by the late Dr. W. C. Daniell:

> In 1817, at a town meeting, it was resolved that about $70,000 should be appropriated by the city to the purchase of the rights of cultivation, in wet culture, of such of the tide swamps as were adjacent to the city. These lands were accordingly subjected to dry culture, by contract, at the price of $40 per acre; and the system went into operation the following year. Its success at first surpassed the expectations of its warmest friends.
>
> Six years have now passed away under the operation of the dry-culture system. Imperfectly as that system has been enforced, it has given proofs the most conclusive of a favorable influence upon the health of Savannah.

The lowlands are divided by the city, thus making two separate drainage systems, one on the east side, the other on the west. There were numerous ponding areas, and the old ditches were filled with a rank growth of aquatic and semiaquatic vegetation which were ideal and prolific breeding places for *Anopheles quadrimaculatus* and *Anopheles crucians*.

In these two areas the construction of dikes along the river to keep the flood tide out was unnecessary, the fields having been filled to a level above high-water mark for some distance back by dredging out the channel in the river and the construction of terminals and slips along the river front.

Through the low lands on the west side runs Springfield Canal, which empties into the Ogeechee Canal at a point about three-fourths of a mile from the river. Springfield Canal is the main drainage outlet for the rice fields through which it passes, also for a large swamp area in the county adjoining the city, several of the county drainage canals emptying into it.

At the time malaria-control operations were started in Savannah, March 20, 1920, the low lands on the east and west sides of the city were in an inundated condition, the drainage and tide gates having been neglected for several years.

The first work toward reclaiming and draining the fields on the west side was to repair the existing tide gate in the Ogeechee Canal. This gate is located at a point near the river and when properly functioning keeps the flood tide in the river from backing up in the canal and overflowing the fields. It allowed the accumulated water on the fields to drain into Springfield Canal, which, when kept at low-water mark, acted as a drainage basin. The accumulated water in the canal basin drains into the river via the Ogeechee Canal through the automatic tide gate at low tide. As a safety factor and to better control the storm water that might accumulate in the main drainage canal, the banks of which are much higher than the ground level of the fields, small tide gates were installed, as was deemed necessary, in the main drainage ditches of the fields. These gates proved their value on several occasions this past season. During the heavy rains the drainage water from the swamps would accumulate in the canal basin at the period of high tide in the river, nearly filling the canal to overflowing. This water is held in the canal by the small gates, running off at low water in the river through the main tide gate.

After the water was drained off the fields and the ground dried out so that a laborer could walk on it without danger of becoming bogged, the existing ditches, which were adequate to drain the land, were cleaned. First the dense growth of aquatic vegetation with which they were filled was removed, rakes being used for this work. Later mud scoops were used to remove the soft mud in the bottom and thus lower the water level in the ditch to low-water mark in the canal. In this way the water level was lowered from 2 to 3 feet, and in many cases the ditch would run dry unless we had continuous heavy rains. No new ditches were dug except a few short laterals to low ponded places.

The operation of draining the fields on the east side differed only in that the main drainage ditches from the fields emptied directly into the river. It was thus necessary to install a tide gate in each main drainage ditch.

Various types of tide gates and sluice boxes are in use in different parts of the country. The type used in this project, with two exceptions, is known as the old rice-field type. This type of tide gate when properly constructed and installed has proved very satisfactory and dependable. It is the type used by the old rice-field planters, having stood the test of years, and best suited to their needs.

The construction of this sluice box differs very little from other types. The shutter, instead of being fastened to the top of the box with hinges, is hung on posts fastened to the side about 20 inches from the outflow end, at the proper angle to conform with the outflow end of the trunk. The gate is hung between these posts on an iron pipe or rod. It is so balanced with weights that it will operate at the slightest difference in the pressure of the water on either side. This type of gate is very easily repaired. It can be raised or lowered for repairs or replaced by a new gate without building a cofferdam around the mouth of the trunk at any stage of the tide.

In installing new sluice boxes, a point to observe in the determination of the elevation of the box with reference to the tide level is the character of the outlet. As far as possible the trunk should be completely submerged a few inches below mean low tide. This is done for two reasons: First, to prevent floating débris from interfering with the closing of the shutter, and, secondly, as a protection to the wood of the box, periodic wetting and drying having a tendency to rot the wood. This is not always practical, however, as a trunk below the level of the bottom of the ditch, on either end, will fill up with mud to the level of the bottom of the ditch, interfere with the closing of the shutter, decrease the cross section of the trunk, and reduce its capacity.

The gate in operation on the main drainage canal in the west-side lowlands might be called the barn-door or canal-lock type. The gate was installed several years ago but was not functioning at the time control measures were started in Savannah. This type of gate is not entirely satisfactory. The weight of the gates alone prevents quick action on the change of the tide, considerable water passing through before the pressure is strong enough to close them. The gates are constructed of plate steel reinforced by iron rods connected by turnbuckles to prevent warping, and are bound on the top, bottom, and sides with 10 by 10 inch square timbers. The side walls and bottom of the flume are of concrete. At the outlet end of the flume the bottom is shaped like a flattened inverted V, the apex pointing down stream. The concrete bottom, being raised about 10 inches above the bottom of the creek, acts as a jamb for the gates to close against. The gates are hung on heavy wooden hinges fastened into the concrete side walls by iron bands.

In the Hutchinsons Island drainage project (an abandoned rice field across the Savannah River and on the north side of the city) two Calco automatic tide gates were installed. The trunk is a section of corrugated iron pipe fitted with the Calco gate at the outlet end. This type of gate is much easier to install than the old rice-field trunk and gate, and the fact that there is no wood about it to rot makes it a very desirable type of gate to use in malaria-control work.

The areas controlled and drained by these tide gates were prolific breeding places for mosquitoes. As early as March both Anopheles and Culex larvæ were found in abundance in these fields. After the fields were drained and the water confined to the ditches, tide gate and fish control solved the mosquito problem in the area this season.

I think these pictures will show more about tide gates than I can in a paper. They show the conditions before and after.

Mr. Le Prince. The next paper will be "Organizations helpful in sponsoring campaigns," by Mr. Clarke.

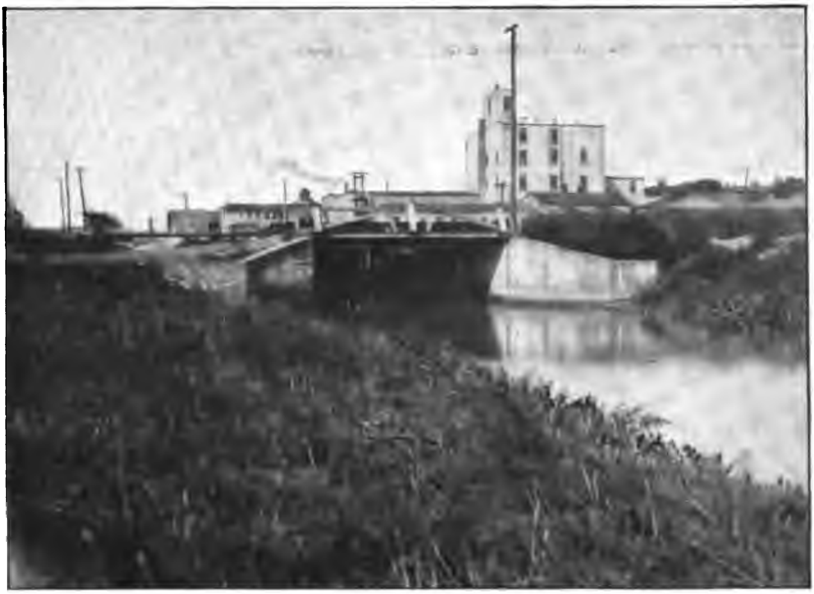


FIG. 10.—BARN-DOOR TYPE OF TIDE GATE, OGEECHEE CANAL, SAVANNAH, GA.

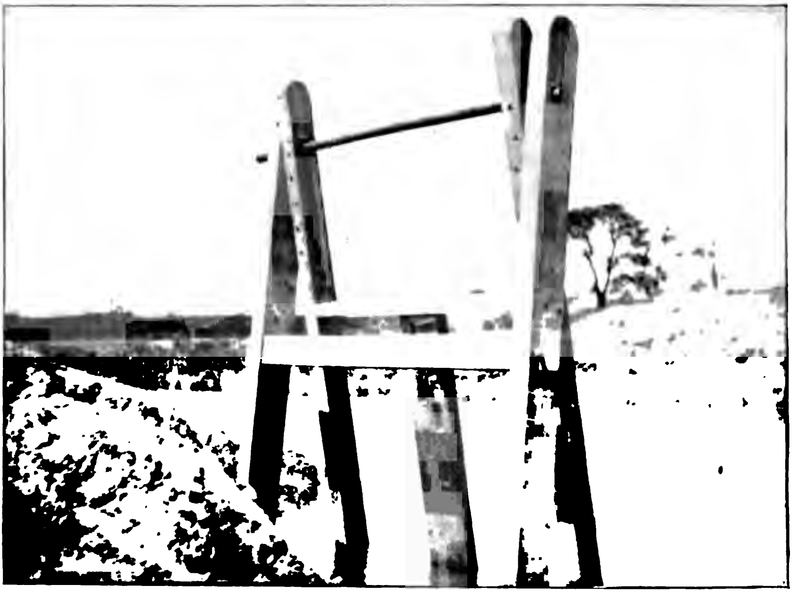


FIG. 11.—OLD RICE FIELD TYPE OF TIDE GATE, SPRINGFIELD CANAL, SAVANNAH, GA.

ORGANIZATIONS HELPFUL IN SPONSORING CAMPAIGNS.

J. L. Clarke,
Sanitary Engineer, International Health Board.

There are no organizations helpful in sponsoring antimalaria campaigns. Local organizations should be called upon only to aid in carrying out the program, after it has been accepted by the city government. A local organization should never be permitted to sponsor a campaign, for this initial act implies that this particular organization is to have the credit, the honor, and the glory of having proposed a work which will meet with the hearty approval of the citizens at large. Such procedure would be an implied rebuke to the city officials for their inactivity in things pertaining to the welfare of the city. It would be resented by them and would cause an irreparable breach. The official health agencies are the only true sponsors for antimalaria work. The Federal Government has assigned its part of this work to the Public Health Service which cooperates with the State departments of health. The representatives of the State board of health then should deal directly with the officers of the city where it is proposed to carry on antimalaria work. It is proper to ask permission of the mayor to make preliminary surveys and estimates of cost. If the project be not feasible, it should be so reported. If good results can be had, the mayor should be requested to call a meeting of the council and there the matter should be presented as a cold-blooded business proposition, and to this end charts and other statistical data now in the hands of the Public Health Service and which represents its past experimental work, should be so prepared as to present these facts in a forceful manner; this would be a great aid to the field directors. It must be remembered that the mayor and councilmen have been elected by the people—they control the city funds, they have the deciding vote, they are responsible to the people, and they are the only ones who can enter into contract with the State board of health. They only should have the full credit for having put over a movement which is to gain favor among the voters.

Should the proposition not find favor among the councilmen, the director's first thought is to take the matter up with some local organization and fight the proposition through. This is dangerous business; it is a waste of time. Very often civic organizations are the outcome of forces opposing those in office. They are antagonistic.

By lining up with such organizations you might master strength enough to force the proposition upon the council, put it over in pomp and glory; but this done, trouble will have just begun. Enthusiasm dies and the crafty opposition with whom you would have to deal can so arrange to postpone, to table, and by various means to let the proposition die a natural death before it has gained sufficient headway to prove its merits. This to the people means that the work has been an utter failure, while if it had been the true wish of those who control the city money it would have been successfully carried out.

This is not idle talk, nor is it without foundation in fact. Experience has taught me that if a thing can not be accomplished through natural laws, there will be a reaction. I can recall no less than five engineering projects, which I proposed to the city council of my home city. Each one had a local organization as sponsor and each one failed. I have seen as many go through because some member of the council presented the scheme. Whether or not it was his own matters not; the point is it came through the proper channel.

I do not mean to speak disparagingly of these auxiliary organizations in city government. There is a place for them and a duty for them to fulfill. Their duty is to aid in carrying out the program, not to sponsor it.

Each organization should be carefully chosen to carry out that particular phase of the work for which it is best fitted. The woman's civic league should be instructed in the care of home premises and aid in the disposal of artificial containers. The chamber of commerce should call attention to the economic importance of malaria control in dealing with business prospects and advertise the work in all printed matter put into circulation by them. The Boy Scouts organization, or the school children, should be by all means taught the field work of malaria control. They will carry it home to their mothers and fathers who will listen with interest, for the boys can present the subject in a manner more fascinating than we can. The newspaper can not be termed an organization in the sense spoken of here, but should be mentioned because of the valuable aid it renders throughout the work. It outlines the campaign in the beginning, it publishes the progress from month to month, it sums up the results, and points out the necessity of continuing the work from year to year. Moreover, it carries the propaganda to nearby towns and this paves the way for similar work in these towns for the coming season. The farmer reads the news and applies the principle to his home surroundings; in this way we may extend the work to rural districts where it is more vitally needed. The local Red Cross unit can render valuable service in taking the malaria history census. Of course, it would be better to have one person well versed in the matter, who knows how to bring out the desired information, do this work in each town in the State. This would insure uniform results and would tend to eliminate in a great measure the personal equation which enters into census taking where several persons are employed. But until the State board of health can furnish such persons, the duty of census taking must be intrusted to the local Red Cross unit and be supervised by the local health officer.

This concludes organizations within the city limits, but the work of malaria control must go beyond the corporate limits of the city. Possibly just outside there is a large manufacturing concern on whose premises a splash dam, a reservoir, or fire-protection barrel gives rise to mosquito breeding. The conditions should be reported to the management with the request that a representative of the concern meet with the city council and determine its portion of the cost of control measures. Large industries are quick to realize the importance of the work and their support is worth while.

So also within flight range of the town there may be borrow pits along the county highway which endanger the health of the community. These danger points were created by the county and should be remedied at its expense. The representative of the city council should be appointed to meet with the county board of supervisors and ask for financial aid or that the existing condition should be corrected by the county road force. The proposition should be explained to the supervisor representing that particular city, and he should be allowed to present the matter to the board.

Often railroad embankments impound water and railroad drainage ditches are not kept in order. In some instances, where no great amount of work is necessary to correct these defects, the section foreman will gladly do the job; but if a large sum is involved, the matter should be taken up with the Public Health Service representative assigned to this railroad, or with the proper railroad official.

There is one other organization which I have not mentioned, and it is a most important one. I daresay it has destroyed more mosquitoes than have been destroyed by the combined efforts of all agencies working toward the prevention and control of malaria; and strange to say the elimination of mosquitoes was not the main object, but rather a by-product. This organization is the drainage district. Public health is mentioned only in the preliminary proceedings merely as a motive to gain recognition by the court; after which brief mention, the question of public health is dismissed and assessments made upon the basis of agricultural benefits to accrue. Notwithstanding the general good accomplished by drainage districts, we find that in specific instances minor drainage or certain other requirements are necessary to eliminate mosquito breeding in drainage canals. To this end we must ask the drainage commissioner to cooperate with us in putting on the finishing touches.

In conclusion I would say the city government should be extended every courtesy possible; consequently, don't let any local organization sponsor your campaign but make a direct appeal to the city council in behalf of your State board of health, being mindful that it is the city council to whom the State board of health will look to carry on the work after the first year's demonstration, and that it is the State board of health upon whom the city council will depend for guidance in after years. Therefore, any act which might tend to create friction or give offence, should be punctiliously guarded against. If, after having presented the offer of State aid and having worked assiduously to gain their favor, your offer is refused, then abide by their decision and pass to the next town. But before leaving, by all means assure them that the State board of health is ever watchful of their interests and is ready and willing to cooperate with them at any time in matters pertaining to the health of their city.

DISCUSSION.

Mr. LE PRINCE. The paper is open for discussion. Mr. Komp.

Mr. KOMP. I would like to take friendly issue with Mr. Clarke. We have both been working in the same State, and my ideas are diametrically opposed to his.

The city councils in both my towns were lukewarm in regard to malaria work. It was only because I managed to get the support of the woman's club in Columbus, which, by the way, is one of the sponsoring organizations, that I was able to put the thing over at all. The city council will not do anything usually unless they think the people want it.

Mr. LE PRINCE. Do you believe, Mr. Komp, that the women's organizations, if they are sufficiently interested, could probably get us the funds we are looking for?

Mr. KOMP. Yes, sir; they did in Columbus.

Mr. STROMQUIST. I agree with Mr. Clarke that the value of these organizations is more in promoting and establishing a campaign than in carrying it out afterwards. Of course, you must first get the city council interested and get these organizations to go before the city council.

In one town the business men's club and in the other town the Lions' Club pledged half of the funds and got the city council to put up the balance. At one time the leading banker got up and said the city didn't have any money, but he said it ought to borrow, beg it, or steal it, but to get it.

Mr. MAGOON. Mr. Chairman, I think it is essential that you go first to the mayor, who is the chief officer of the town, and then make the next call on the health authorities that may be there, but let the mayor know your mission, and get him to ask you to study conditions and advise him regarding the situation. The mayor usually refers you to organizations that may be helpful.

You assume considerable responsibility when you try to get the woman's club or other organization to force the mayor and city council. I think it best to have the mayor and city council know your purpose before appeal is made to other organizations.

Mr. **Woodfall.** Mr. Chairman, I do not quite agree with Mr. Magoon on this matter. I believe in going into a city or town to make a malaria survey the first man that should be seen is the local health officer. If you ignore this man at first, you are going to have trouble from start to finish, as after your work is completed it is the local health officer who must carry it on. It is the local health officer who should introduce you to the mayor and members of the city council.

I have found in several cities that the part-time health officer sits on a high throne and he must not be ignored.

Dr. **Fricks.** Gentlemen, in my judgment, Mr. Clarke has quite clearly defined the difference between the proper sponsors of an antimalaria campaign and the assistants in such a campaign. The legally constituted health authorities are the true sponsors for work of this character, and the Public Health Service can legally cooperate in health work of any kind only with the legally constituted State and local health authorities. Now, when it comes to securing local assistance and stimulating favorable local sentiment for malaria control, we all realize the importance of securing advice and help from local organizations—woman's clubs, chambers of commerce, etc. Assistance from these sources can never be wisely neglected, but the method of securing it must be left to the judgment and tact of the sanitary engineer in charge of the work.

Mr. **Le Prince.** Does Mr. Clarke wish to make any further remarks?

Mr. **Clarke.** Only one thing. It is proper to get the support of these other organizations if it be requested of you by the mayor and council to determine the sentiment of these organizations, but otherwise you have got to abide by the rulings of the people or the officers the people elect. You can't afford to create any harsh feelings between those in power and the State board of health. I might say that even though a campaign is supported by outside parties, enthusiasm soon dies, and the funds might by some means be curtailed or misappropriated, and you would be shut off without any funds whatever, so you had better stick close to the council and the mayor.

Mr. **Le Prince.** The next paper will be "Foreman and labor problems," by Mr. Lenert.

FOREMAN AND LABOR PROBLEMS.

L. G. Lenert,

Assistant Sanitary Engineer, United States Public Health Service.

The plans and methods of procedure discussed at this conference will naturally be helpful to one and all of us, yet I feel that no matter how complete the plan devised or how efficient the methods employed, the success or failure of malaria control depends chiefly upon its proper execution. The personal equation is really our most important consideration. The effective direction of labor and the interest manifested in the work are vital factors of success.

In any line of endeavor one must be interested in his work, but in the control of malaria there must be more—there must be enthusiasm and a determination to conquer at all odds. There must also be that spirit of optimism, as Mr. Le Prince once explained to me, of never becoming discouraged, no matter how gloomy the outlook. This is not the natural disposition of one out of ten of the men one is able to secure at the salaries and wages at one's command.

For purposes of economy and also for the additional and very important purpose of tying the work to the ordinary activities of municipal administration, the selection of a director already on the pay roll of the community would seem wise. We must not be misled, however, by false ideas of economy. Sometimes we are successful, but the chances are that instead of securing a valuable field marshal one more often finds he has a very poor lieutenant who will depend on the buck private to do his work.

In most of the communities in Texas where malaria-control operations are being carried on, the economical handling of the work will hardly permit of employing more than one full-time man for the entire season. Additional assistance will perhaps be required from time to time, but the work will depend chiefly on the full-time man. He must be a combination of foreman, inspector, oiler, laborer, and must understand and put into operation the methods of fish control. Such a combination is not met with in every community. Where it can not be found a part-time foreman and inspector is selected to supervise the work of a laborer who must, due to the nature of the operations, spend most of his time alone.

The results are very seldom what they should be, because this arrangement places too much dependence on the laborer, and the part-time foreman and inspector is very apt to be away when his services are most needed.

A better plan to follow would be to combine the wages of the laborer and the salary of the part-time foreman and secure one man to be held responsible for all results obtained, depending upon him to do all inspecting, oiling, and fish-control work personally. Where this man has been previously schooled in the work very good results can be had. I would like to mention a plan suggested and carried out to a certain extent in Texas during the past season. The town of Cameron was very desirous of putting on an antimalaria campaign, but could be assured of very little financial assistance either from the State board of health or the other cooperating agencies. It was suggested, however, that if the town would send a man to one of the units already in operation to learn the methods employed it would be possible to extend advice and general supervision of the work to Cameron. A man was sent to one of the units for education. After two weeks of instruction and with an occasional visit from the sanitary engineer in charge he was able to accomplish very good results. I might mention that this man did not hesitate to apply himself to this work in all of its phases, including carrying the Meyers knapsack sprayer.

The people of Cameron are more than satisfied. The work was begun late in the season and was considerably hampered by a shortage of funds, but the results obtained will more than justify the expense; and the town will continue the work during the coming season.

The training of men to carry on this work in small communities, at one of the units where intensive control work is being instituted, is to my mind one of our best methods of expanding this work to the largest possible population. The plan to be followed, including methods of procedure, must of necessity be obtained from an experienced field man, generally the sanitary engineer.

The knapsack sprayer may possibly be an item of equipment, and as such seems to have no place in this paper, but it has a very direct relation to our labor problem. I haven't the remedy to offer but it has been my chief obstacle in securing competent labor. In the city of Monroe, La., no less than 30 men were employed and more than a month's time consumed in training them before three men for permanent oilers were finally obtained. These were not men of especial fitness for the place but such as could be secured. White labor was tried but not kept long, due to the spilling of oil on their clothes and bodies. The only consideration which enabled us to keep our oilers was the 25 to 50 cents increase in the daily wage. A better method of oiling should be devised or improvement made in the Myer's knapsack sprayer.

Trained men are necessary in this work and it is important that the employment of both foreman and laborers be permanent in order that the following season can be properly taken care of. The form that this permanent employment must take will not be the same in every community. A large town which can support a health department will probably be able to use the men in sanitary privy construction or other sanitary lines. The problem will be the small towns—how to retain the force in municipal lines during the inactive season. This is one of our principal problems, and though each individual community will present its own particular difficulties, the experience of those present will no doubt be helpful to all.

This retention of trained men is one of our chief concerns, and while the instruction of the people in general is very important and the success of the work is largely dependent on this, I feel that it will always be necessary to have men to actually see that the work is carried out—men who are trained in all phases of the work and alive to grasp any new developments which may come to hand.

DISCUSSION.

Mr. LE PRINCE. Any discussion?

Mr. PARKER. I think it has been mentioned before, but in connection with labor I think it should be emphasized that the construction work of antimalaria campaigns should be done in the winter months before the active mosquito season sets in. In agricultural communities, such as most of us are operating in, that is the time when labor is most plentiful and when it can be obtained for the lowest possible wage. I think that will eliminate the high cost of labor experienced during the past year, in communities where they were paying excessive prices for cotton chopping, work in the mills and gins, and so forth.

Mr. LE PRINCE. That point is well taken.

Mr. KOMP. I think Mr. Parker's suggestion is a very excellent one. In most of the territory in the South in which our work is done, the greatest rainfall occurs in the winter and spring months, with the dry season in late summer and autumn. From about the latter part of August on there was no standing water anywhere in my towns, even large swamps and wet-weather streams going dry. The effectiveness and economy of our work could be increased if most of the drainage work were done during this dry season, rather than during the spring and early summer, when the ground is covered with water. Maintenance expenditures would doubtless be increased, but would be compensated for by the decreased cost of ditching unhampered by mud and deep water. If possible, also, fall campaigns in certain places could be arranged to begin immediately after the cotton crop is picked, when there is no outside demand for labor. With more abundant, and consequently better labor, working on dry land, unhampered by boots, which are an important item of expense, I think our results would be much more satisfactory than at present.

Mr. Le Prince. The next paper will be "Malaria statistics" by Mr. A. W. Fuchs.

MALARIA STATISTICS.

A. W. Fuchs,
Associate Sanitary Engineer, U. S. Public Health Service.

A knowledge of the prevalence of malaria is essential in antimalarial work. First, it serves as a guide in the selection of places for campaigns. Where malaria is scarce the appropriation required for control measures may be so large as to be unwarranted in view of the limited results attainable. Again, where for some reason or other the choice is limited to one of several towns, preference should be given to that place where the cost of control will be a minimum per case of malaria. Secondly, it affords a measure of the effect of antimalarial campaigns, not only from year to year, but from month to month during the period of control. Most important of all it is of paramount importance in establishing the need of appropriations for contemplated work and in justifying the investment made in work already undertaken.

Malaria figures may be obtained from State or county morbidity files, from physicians' reports of the percentage of their practice contributed by malaria and of the number of cases or calls for malaria, from a malaria census, from prescriptions for malaria on file at drug stores, from claims and benefits paid for malaria by industrial and health insurance companies, from sickness records at mills, and from absences from school on account of malaria.

State and county morbidity records, because of their easy access, would be ideal sources of malaria statistics were it not for the unfortunate fact that very few States require malaria reporting. To be sure, the returns from this source are incomplete during the first few years, but the sooner such reporting is made compulsory in each State, the earlier will reliable figures become available for future use. It should be the policy of State health officers in those States where malaria is a serious problem to obtain legislative provision for adequate malaria case reporting. As there is no such data available for North Carolina, where I have done most of my malaria work, I shall refer to Dr. Leathers's paper read at the convention of the Southern Medical Association at Louisville, Ky., November 15, 1920, for a further discussion of this subject.

In the absence of State and county reports it is natural to turn to the practicing physician for such information. Estimates by doctors of the percentage of their practice during the summer and fall contributed by malaria constitute a preliminary guide to the desirability of an antimalaria campaign. At Goldsboro, N. C., these estimates varied from 10 to 75 per cent, and averaged 28 per cent for the five doctors interviewed. Dr. Rankin raises the point that if similar percentages were obtained from the doctors for all the common diseases the total would often be above 100 per cent. As I have never tried this, I am not in position to deny his statement. However, the estimates made by Goldsboro physicians were later closely substantiated by figures submitted by three insurance companies whose records showed that during 1919 the claims paid for malaria constituted 22 per cent of all claims for sickness paid by these companies in Goldsboro.

Physicians' current case reports are not nearly so difficult to obtain, especially if solicited at intervals, as records for past years. It is easier for the doctor to promptly record a case just visited than it is for him to search his records for cases occurring during an entire year past, and he naturally balks at such a task. It would seem best, for the sake of better cooperation by physicians as well as greater accuracy in records, to arrange for the doctors to start their malaria case records a year in advance of an antimalarial campaign. Instead of necessitating a lengthy search through an entire year's daybook or account book, or worse still his memory, for names of patients who to the best of the doctor's recollection were treated for malaria, such a plan would make available accurate records with little trouble to the doctor. In the cooperative towns of North Carolina only one-fourth of the doctors kept individual case records for 1919, whereas during 1920 case reports were obtained from over three-fourths after they had been supplied with proper forms and impressed with the necessity for records. The following table illustrates this difference in the value of the figures for the two years:

Malaria cases reported by doctors at Goldsboro, N. C.

Month.	1919 total.	1920[1]			
		Probably contracted elsewhere.	Previous history positive.	New local cases.	Total.
January	3				
February	4				
March	5		2		2
April	7	1	4	5	10
May	9	1	2	4	7
June	17	1	8	2	11
July	71	4	3	5	12
August	137	5	3	13	21
September	162	1	7	4	12
October	127				
November	95				
December	6				

[1] From Jan. 1 to Oct. 13.

In the above table, as well as in the chart representing the table graphically, the 1919 cases of only those eight doctors who also reported their 1920 cases are included in order that a proper comparison between the two years may be made. Thus, there was a total of 75 cases from January 1 to October 13, 1920, while for the same period in 1919 there had been 470, or a reduction of 84 per cent. The value of individual case records giving histories of the cases, as summarized for 1920 in the above table, lies in the clue provided as to the success or failure of control measures, for the occurrence of chronic cases or of cases contracted elsewhere is not to be credited to the failure of the control work. Furthermore, the collection of reports at frequent intervals will serve as a check on the satisfactory progress of the work, as an unduly high report will point immediately to a weakness in the control, which may be rectified without delay.

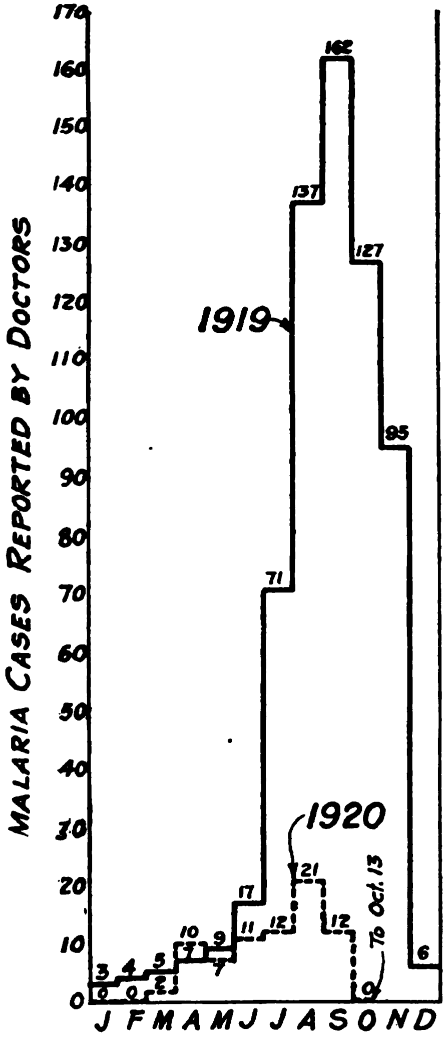


FIG. 12.—Malaria cases reported by months for 1919 and 1920, Goldsboro, N. C. (Cases reported by 67 per cent of all physicians.) A. W. Fuchs, November, 1920.

The cases for 1919 were obtained by personal calls on the doctors. For the 1920 cases printed forms were first mailed, and the doctors were requested to supply the name, address, age, sex, color, date first seen, length of residence in town; and date of last previous attack for each case. Few of the doctors gave all this information, in fact some did not enter their cases on the forms until they were personally called for; but on the occasion of such call the doctor was asked for a history of each case with reference to places of residence during the month immediately preceding the attack, and also to its acute or chronic character. It is significant to note that a number of personal calls, in some cases half a dozen, were made on the doctors before their 1919 cases were obtained, while later those for 1920 were received usually on the first visit. There is no doubt that the mailing of requests to the doctors for their cases placed them on the defensive when the data was later called for in person.

While information for past years obtained from the doctors' case records, day book, account book, or from memory, as the case may be, is not 100 per cent accurate, it is often the best, sometimes the only information available. I have found them more reliable in North Carolina than returns from malaria censuses. The important point to remember is that the reliability of such data depends on the percentage of doctors reporting. Figures obtained by applying to all the doctors the average number of cases reported by 10 per cent of the local physicians may be questionable, but averages of reports from 70 per cent can not be far wrong in estimating the total number of cases treated in a town.

Returns from malaria censuses may be reliable under certain conditions, but our experience in North Carolina has been discouraging. At Goldsboro, the population of which is 11,300, two separate censuses taken by different persons but for the same year gave returns that were far apart. The first, taken in December, 1919, by four members of the woman's club, and covering 6 per cent of the population, showed positive histories for 1919 in 21 per cent of the persons interviewed; the second, taken two months later by two men from the State board of health, and covering 17 per cent of the population, showed only 3 per cent positive histories. An investigation of this decided discrepancy was made by selecting homes visited in both censuses and by revisiting these places in company with the women who had taken the first census. It was found that in some instances the persons interviewed, all whites, admitted having correctly reported cases to the woman census taker, with whom they were acquainted, but having deliberately lied to the men, who were strangers. The motives that prompted such action were evidently a dislike of publicity, a disinclination to supply the information to strangers, and possibly a vague fear of quarantine. In another instance the woman census taker had made returns that were inaccurate, purely out of zeal for the antimalaria campaign. The investigation showed, therefore, that whereas in some instances the women's returns were correct, in others they were too high; also that the men's figures were too low. But there was no way of arriving at the correct figures from these returns.

But census taking in colored sections we found even more difficult than among whites. Out of 50 homes visited in Little Washington, a colored district of Goldsboro, only two positive histories were obtained. Yet one negro doctor reported treating 350 cases of malaria in Little Washington during 1919. The darky is by nature secretive regarding such matters and entertains a fear of quarantine or vaccination in spite of all explanations to the contrary. On a number of occasions I have managed to obtain frank reports from Negroes by explaining that I was anxious to find out whether they were bothered with mosquitoes and malaria, and that if there were enough to warrant it, we would undertake work to get rid of them.

Malaria census data have the disadvantages, compared with doctors' reports, of being more difficult to collect and of not being available until after the end of the year. Where they can be reliably obtained they have the advantage of revealing all cases of malaria, while the doctors' reports take no account of cases that are "home treated." But for satisfactory census returns the census should be taken immediately after the end of each year to eliminate errors of memory; it should be taken by the same person for successive years to avoid differences due to personal equation; it should be taken preferably by a trained local nurse who is acquainted locally and who can recognize a history of malaria.

The use of doctors' prescriptions on file at drug stores as a measure of the prevalence of malaria was attempted at Goldsboro immediately after the inadequacy of the census returns became apparent. The prescriptions were examined by a young physician detailed by the State board of health, and the data were compiled by myself. Because of the tremendous number of prescriptions on hand, only those filled during the four summer months from July to October, 1919, were examined. The results obtained in the two drug stores visited were remarkably close. Out of 3,219 prescriptions examined 125, or 4 per cent of the total, were for malaria treatment. Prescriptions considered as indicating malaria were those in which more than one-half of the active ingredients consisted of quinine and those for Warberg's tincture and for Vinatone and Febritone, proprietary remedies prescribed by some of the local physicians for malaria patients with intolerance to quinine. Only prescriptions by resident doctors were included. If the average for the two drug stores visited be applied to the 10 drug stores in Goldsboro the total number of malaria prescriptions would be 625. It must be remembered that this figure takes no account of verbal prescriptions for antimalaria treatment or of "home treated" cases. This source of data, therefore, can not supply information covering the total prevalence of malaria. But for the purpose of arriving at the comparative prevalence from year to year and for measuring the percentage reduction due to antimalaria measures, an examination of prescriptions will give reliable results because errors of memory and those due to personal equation of the investigator are eliminated. Furthermore, this source of data is available on short notice whenever desired.

Where the records of industrial and health insurance companies are available the data is reliable because no claims are paid without medical examination. The local insurance agent will seldom have the desired records in proper shape, but the home offices will usually have them on file. Most companies appeared willing to submit information when assurance was given that the identity of the records would be considered confidential. An idea of the possibilities, also the limitations, of this source of information may be obtained from the following table:

Insurance companies' reports of malaria for Goldsboro, N. C., 1919.

Insurance company.	Malaria claims.	Malaria benefits.	Total claims all causes.	Total benefits all causes.	Total policy-holders.	Percentage malaria claims of total claims.	Percentage malaria benefits of total benefits.	Percentage malaria claims of total policy-holders.
A	79	$320	682	$2,803	2,096	11.6	11.5	3.8
B	[1] 312		[1] 548			56.8		
C [2]								
D	65	294						
E	95	235	939	2,964	1,625	10.1	7.9	5.8
F [3]								

[1] For 6 months ending March, 1920.
[2] Keeps no separate records.
[3] No reply.

The information requested included malaria claims, malaria benefits, total claims for all causes, total benefits for all causes, and total number of policies in force, by months for 1919. The above tabulation shows how much of this data was submitted. Of the six companies consulted, two gave all the figures, two submitted partial data, one kept no separate records for different towns, and one made no reply. The number of claims paid for malaria varies from 10 to 56 per cent, averaging 22 per cent, of all claims paid for sickness. The relation between malaria benefits and total benefits, for the companies that presented these figures, is approximately the same as that between malaria claims and total claims. It is interesting to note that claims for malaria were paid to 5 per cent of all policy holders. It was expected that this figure would represent the percentage of the city's population having malaria, but it is evidently less than the latter, because some malaria cases do not apply for claims, particularly in light attacks, while chronic cases having no acute attacks probably receive no benefits. It seems, on the whole, that if all insurance companies operating in malarious sections were impressed with the benefits they derive from antimalarial work, better cooperation would be obtained from them.

At the large mills where adequate medical supervision is provided records may be available showing malaria cases, time lost on account of malaria among employees, and increased production following malaria-control operations. Such is not the case in the demonstration towns of North Carolina.

Absences from school on account of malaria constitute an impressive argument for malaria control before women's organizations. At Farmville, N. C., school records of absences were looked up, and notes were sent to the parents of the absentees requesting them to indicate absences due to malaria. Out of six grades with a total enrollment of 178 pupils, 47, or 26 per cent, had been absent because of malaria between October 1 and December 31, 1919. For the 24 cases in which the length of absence was reported the accumulated absences totaled 261 days, or an average of 11 days per case.

The need of more data of this kind is urgent because of its value in support of antimalaria appropriations. Were representative figures at hand it would be possible to present convincing financial statements to those business men to whom the mere prevention of disease and distress makes no such strong appeal as the promise of large dividends on an investment. It could then be shown, for example, that at Goldsboro the reduction of 84 per cent in malaria cases meant a saving of 810 cases in 1920; that each case of malaria among working people represents two visits by the doctor at a cost of $4; a loss of 11 days' wages, at $4 a day, making $44; $1 for medicine; or a total of $50; that one-half of the cases thus prevented would have occurred among workers; and that the resulting saving of $20,250 to the citizens of Goldsboro represents a dividend of over 300 per cent on the city's investment of $5,026 for malaria work in 1920. Of course, such a statement does not show the loss in curtailed production for the manufacturer, in smaller volume of business for the merchant, in diminished freight for the railroad, in reduced real estate values and rentals, or in any of those factors which stunt the economic growth of a community, but to which definite cash values can not be assigned.

How do the malaria figures from different sources compare? At Goldsboro the average of the two 1919 malaria censuses indicated that 12 per cent of the population had malaria; doctors reported that 966 cases, or 9 per cent of the population, were treated for malaria; drug stores showed 625 malaria prescriptions, or that 6 per cent of the population had prescriptions filled for malaria; and insurance companies indicated that 5 per cent of their policyholders received benefits on account of malaria. When the figures for 1920 are available, it will be interesting to compare the percentage reductions derived from the different sets of data.

In conclusion I would urge that State health officers obtain and enforce legislation for State-wide malaria reporting; that doctors be supplied with forms and requested to keep malaria case records beginning with the year preceding control measures; that malaria censuses be taken for successive years by a local trained nurse; that better cooperation be obtained from insurance companies; and finally that each man present make every effort to collect data showing economic losses due to malaria in such mass that representative figures will eventually be available.

Mr. LE PRINCE. The next paper will be "Surveys and maps," by Mr. Buck.

Mr. BUCK. Mr. Chairman, although my subject is surveys and maps, what I have to say is chiefly concerned with a discussion of what Mr. Fuchs has already mentioned in his paper on "Malaria statistics."

SURVEYS AND MAPS.

C. E. Buck,

Sanitary Engineer, International Health Board.

Surveys and maps form the foundation upon which the malaria-control demonstration work is to be built. Since the time is altogether too limited to present the entire subject, I shall confine myself chiefly to the discussion of what I believe to be the cornerstone of this foundation—the securing of an accurate malaria index.

The object of our demonstrations is to prove to the people in the various States in which we are working that in an urban community malaria can be eliminated and at a cost which will insure an actual economic saving to that community. How are we to prove to a city council that we have effected a saving for their city unless we know what the malaria status of that city is and has been?

Granted that we must know this, how shall we go about getting that figure? The general methods of getting a malaria index are familiar to us all, and it is hardly reasonable to suppose that any brand new method can be devised, yet I believe that we can make better use of the tools with which we are already working. There is no single method or, for that matter, any combination of methods which will give us an absolutely accurate figure. It is, however, probable that some sources of information will give us a figure which is correct within certain limits, say a few per cent. It is for us, then, to take the means by which we can arrive at the more nearly correct figure, to avoid such mistakes as can be avoided, and to correct for, in so far as we are able, the unavoidable inaccuracies.

In order to make clear some of the difficulties which we encounter, let us discuss for a moment the various sources of information which we are at present using in the establishment of such an index.

In the malaria census made by a house-to-house canvass we can, of course, avoid the errors which would inevitably result from taking too low a percentage of the population or from confining too large a percentage of our interviews to one particular part of the community. Naturally the more evenly we distribute our interviews over the entire community and the larger the percentage of the population we take the more reliable will be our figure. The question may well be asked, How low a percentage of the population can be included and still give us a dependable result? It seems to me that it depends very largely upon the size of the town. For example, 10 per cent of a city of 10,000 would probably be ample, whereas it would obviously be unfair to depend upon results obtained from only 10 per cent of a town of 200. Would it not be well for us all to come to some agreement as to the minimum percentage which could be taken in towns of varying sizes, and still give us fairly accurate results?

By whom should such a census be taken? If taken by some local organization such as the Woman's Club, civic league, or high-school students it is found that the resultant figure is often too high. This is particularly true in a community where the people are anxious to have the work done, and in their zeal to have the program go through exaggerate the amount of malaria which exists. On the other hand, local organizations often fail to interview many of the Negroes, who usually live on the outer edges of town, where malaria is most prevalent, with the result that in this respect their figure is too low. Thus from one cause we appear to get too high a percentage and from another too low. Will these inaccuracies in opposite directions tend to make the total result fairly nearly correct? It is, I think, doubtful, and where there is no particular anxiety on the part of the people toward taking up the work we shall probably get a figure which is too low.

When the census is taken by trained men, usually outsiders, we seem invariably to get too low a percentage of infection owing to the fact that people are loath to admit to outsiders that they have had malaria. Negroes are particularly prone to say no to any questions regarding malaria for fear that an affirmative answer will lead to vaccination or quarantine.

Doctors' reports will, I believe, give us the most reliable figure upon which to base our estimate of savings which will accrue to a community as a result of getting rid of malaria. But the question naturally arises as to what percentage of the doctors it is necessary to get reports from? May we take 50 per cent, or must we have 75 or 80 per cent? This would depend upon the number of doctors. If we had 20 doctors and got reports from 10 of them it would probably be justifiable to use these figures. If, however, we have two doctors and only one of them reports it is doubtful whether his figures would be representative of the whole community.

What shall we do with the doctors from whom we are unable to get reports? Shall we disregard them altogether; shall we assign to each one the average number of cases as represented by the reports of the other doctors in the community; or shall we assign to each the lowest number of cases reported by any of the doctors? It would seem to me to be fair to count each one as having the average number of cases. Let us try to come to some agreement as to the policy to be adopted in this case as well as in all other cases in which there could be any doubt as to what policy to pursue.

Although every effort should be made to get cases of malaria, and only such cases as occurred within the corporate limits, it may in some instances be impossible to get anything better than total calls for malaria. Where such a condition exists are we justified in assuming that a case of malaria will average two calls and dividing the number of calls by two in order to get cases? I found that it was the general consensus of opinion among about 30 doctors interviewed that a malaria case would not average 2 calls. Of course we ought to have a great many more figures before accepting this as true, but it at least seems reasonable.

What relation exists between the number of cases of malaria as reported by doctors and the total number of cases in the community? It is probable that not over half of the people having malaria see a doctor, but this is merely an assumption. Headquarters should be able to give us some valuable information on this point by comparing the figures of the house-to-house census with the doctors' reports.

Although druggists' prescriptions and records of sales of chill tonics, insurance companies' reports, and mill and factory statistics, may be extremely helpful, and, perhaps, in some communities of paramount importance, in general they can not be relied upon as the chief means of getting a malaria index.

All of this discussion leads us to the conclusion that, although all methods have there inaccuracies, some are more reliable than others; that we are not all using the same method or combination of methods; and that even should we use the same method there would still be a great variation in the way in which we adjusted the information obtained.

It is to be hoped that as a result of this discussion we shall all come to some agreement, both as to the best method to be used in establishing a malaria index, and as to the adjustment of the information gathered by this method.

It is my personal opinion that doctors' reports should be adopted as the means of securing the index. Although subject to certain inaccuracies and not giving us the actual amount of malaria, they will give us a minimum malaria index which is practically indisputable. With doctors' reports as the basis of our figure we can say that we have at least so much malaria, probably a great deal more, but certainly not less.

As to the policy to be adopted in gathering and adjusting the information, I believe that we ought to have at least a majority of the doctors reporting; that we are justified in assigning to doctors failing to report the average number of cases as reported by the other doctors in the community; that every effort should be made to get cases of malaria, and only such cases as occurred within the corporate limits, but where we have only calls it should be permissible to divide the calls by two in order to get the cases. Beyond this, if we are to keep our figure in any way reliable, I do not believe it wise for us to change the figures as reported.

Just one more point which Dr. Rankin wanted brought up. How high a percentage of malaria must we have in a community in order to justify our going ahead with a malaria-control demonstration? Personally I do not believe it depends upon percentage at all. It seems to me that it is a comparison of the cost of malaria to a community with the cost of getting rid of it which will determine our decision. This brings up the question of how much does a case of malaria cost a community? If we could get some reliable statistics on this cost it would be very simple, with the number of cases and the estimate of the cost of the work before us, to determine very closely what savings we could effect for any given community.

DISCUSSION.

Mr. LE PRINCE. Dr. Bass, after extensive investigations in Mississippi, says he found that about one out of every five cases in the colored population sees a doctor.

Mr. JOHNSON. My doctors didn't sign up either. I told the State health officer in July that I wasn't getting these reports. He said, "Oh, I think I can get them for you, and I'll do it." But he hasn't had much more success than I did, and recently told me it just couldn't be done. If the State health officer can not get them to make these reports, how much effect do you think the pleading of an engineer will have?

I don't want you to think that I am degenerating into a mere attack on doctors. Our Alabama doctors have supported the work magnificently this year, and have given of their time and efforts unstintingly. I believe the success which has attended the work is due to them perhaps more than to any other one cause. But the very doctors who have helped the most are the ones who simply will not report cases. We can not rely on using the cases reported by the doctors as the index of the amount of malaria in Alabama, for if we did we would be forced to the conclusion that there was practically none of the disease in the State and that malaria control work there was needless. I think we all know that such is not the case, and we must gauge the amount of malaria in Alabama by some different method.

Mr. STROMQUIST. I wasn't able to get any reports last year or this year. The doctors don't report malaria. The most discouraging part of the work to an engineer is that he can't get data to show what results he has accomplished, particularly to an engineer who is accustomed to dealing with accurate figures.

Mr. LE PRINCE. I would like to ask if there is anybody here who has succeeded in getting statistics that were valuable.

Dr. BARBER. I do not claim to have succeeded in getting accurate statistics of malaria incidence, but I will tell what I tried to do in one town. Through the cooperation of local physicians I attempted to secure blood slides of cases suspected of malaria before quinine was given. A fair number of slides was obtained, only a small percentage of which showed parasites. Again,. we searched for cases by means of a house-to-house canvas and examined blood slides of all cases at all suspicious of malaria. We employed a third method, one which has been mentioned in this meeting, the determination of the percentage of absences from school due to illness. In this town absences due to all sorts of illness during the relatively malarious weeks between the middle of September and the middle of October was only about 3.3 per cent of the attendance. Further, we determined the parasite index of two colored schools. This index, about 5 per cent of nearly 70 persons examined, compared favorably with a school I once examined in the Philippines, which gave nearly 60 per cent positive at one examination.

Dr. **Fricks.** I should like to say just one word about malaria statistics. I can't get away from the idea that the State health officer is properly responsible for the determination of the prevalence of malaria in any community within the State. That seems to me to be perfectly evident and clear. Also that the sanitary engineer ought not to be expected to make a survey for the determination of malaria prevalence in any town in which he comes to do drainage work.

I realize some of the difficulties under which you are placed in the field, and that your interest in the work will prompt you to use every method that comes to your mind in determining just how much malaria there is in your community so you can show just what you have done at the end of the season. But I think that the State health officer should furnish information as to malaria incidence in selected towns and is actually responsible for this information in carrying on his part of the cooperative agreement under which we are working.

I agree with Mr. Buck in the statement, which I understood him to make about the doctors' reports, that in the beginning they should be considered as the minimum standard of malaria prevalence.

Now, as to the doctors' monthly reports, I did not hear anyone answer the question as to how many of you were getting such reports. But these reports are provided for in our original agreement—the doctors in each one of the towns should furnish a monthly report of malaria cases treated. Now, understand this is separate from the report that Mr. Buck mentioned as the minimum standard in the beginning, but in carrying on the work all through the season you are expected to get from the doctors in your community a monthly report of malaria cases. I don't know how many of you got those reports; there are some that did, but in case you are not getting them the sanitary engineers should report that fact to the State health officer, and ask him to assist in carrying out this cooperative agreement that we have entered into.

Mr. Magoon. Mr. Chairman, I have had the city councils present the matter of malaria reports to each doctor. We have tried to insist that each physician give information each month that would let us know who had malaria. I need to have knowledge of where cases originate in order to control the antimosquito measures. The names of the patients were of value in assisting us to distinguish new cases from old. It is a much better point with the doctor to tell him that you wish data to enable you to learn of outbreaks of malaria so you can guard against further spread, than to try to get figures for statistics that he cares nothing about.

I have practically complete records of physicians' malaria reports for each month beginning last June. But I had to go to each doctor every month in order to get them. Reports giving names of a dozen cases of malaria from neighboring houses in one section of Groveton led us to discover an important Anopheles breeding place in a back yard. This was in June. I learned of no new cases developing in this block during the remainder of the year. Prompt control was possible because of the knowledge of the location of these cases.

Mr. Old. I am glad to hear that some States are in the same class as Georgia with regard to doctors' reports. I have about 25 doctors and I can't get figures from any of them. It is not intentional; they are just not used to figures.

I had an inspector in two towns take a malaria census. He uses the regular malaria census cards to get cases of malaria, and these cards are referred to the doctors for confirmation. In that way I think, I got very good results.

Mr. Shaw. I want to ask a very direct question of Dr. Fricks and Mr. Le Prince: What is the best plan for making maps of the preliminary survey? And do you think it is advisable, at the completion of the demonstration, to prepare a tracing showing all ditches, so that a new engineer, the local man, or even a stranger to the work, can easily locate all water courses with which he will be concerned? I did this in the case of Baton Rouge, showing the block line dotted and the streams and ditches as solid lines.

Mr. Le Prince. Not only do I think that should be done but I think every breeding place should be plotted on that map. I am referring to natural breeding places, but you will find later on as you work in different sections there are certain sections where possibly once in six years, say, there will be formed new temporary production areas, but in all cases try to have every known place marked down so the new foreman will understand where his work is.

It isn't essential to push other more important work out of the way in order to make an accurate map, but there should be a map that is sufficiently accurate for practical purposes. Not only should that map be made, but a copy of that map should be left with the local health officer, and a copy sent to headquarters.

Dr. **Fricks.** I would like to mention the map that Mr. Johnson sent in with his preliminary survey. It seems to me this little sketch map, showing the town, its location on the railroad, and the drainage and streams, is really valuable. At least, to me it was. I don't know how much time it took Mr. Johnson to prepare those sketches, but I think they were good.

Mr. **Le Prince.** Those sketches served a good purpose, and I think should be made whenever possible. It took only a little time.

Mr. **Komp.** Mr. Buck, I think, has had some experience in surveying from airplanes, and he may be able to tell us something about it.

Mr. **Le Prince.** I would like to hear it.

Mr. **Buck.** I had a little experience in that line. The field was located on a prairie, and the first thing I did, at the suggestion of the health officer, was to take a flight over the prairie surrounding the field, and I could see the main drainage system very well. I got a mighty quick and comprehensive idea of the main drainage system. Of course, following that I had to make a survey on foot. I think that some one during the war had taken a flight over the territory to map roughly the main drainage system in that section.

Mr. **Komp.** During the war I had the opportunity to take some photographs showing the very intricate drainage system on the Mississippi coast. Some seaplanes, attached to a naval recruiting flotilla, were available, and with the permission of the commander I was able to get two dozen very interesting photographs. Even in very heavily wooded swamps the water was visible through the trees, and the photos supplemented our maps to a very great extent.

At one of the local photographers' in Tupelo, Miss., I saw some large aerial photographs of the town taken from a plane by fliers from Payne Field, near by. These photos showed every bit of the drainage system, including some outlying ponds that my foot survey had missed, and from them it would have been possible, without anything else, to make all the maps necessary for the report to headquarters. I obtained copies of these photographs, and intend to incorporate them in my annual report.

Mr. **Buck.** I had the good fortune to fly in the Army for a couple of years. During that time we made a good many photographic maps. As you may know, the cameras used on an airplane are so adjusted that at a given altitude a given ground area will be taken. In this way a series of photographs can be put together to make a map the area of which is definitely known. There is no question in my mind but that an airplane is admirably adapted to many phases of our work. The use of an airplane is not nearly as expensive as one might be led to believe, and it is my opinion that one could be used advantageously by the cooperative malaria-control agencies.

Mr. LE PRINCE. I will ask Mr. Buck to close the discussion.

Mr. BUCK. Mr. Chairman, I heartily agree with what Dr. Fricks said in regard to the State health officer being responsible for the malaria statistics of his own State. But some of the State health departments haven't the machinery necessary to get that information, and until they get it we must use other methods.

It is perfectly true that the doctors will not send in reports, and the only way we have been able to get reliable reports from them is to go to their offices and sit down with them and go over the records, which is a long and laborious process; but I don't know of any other way of getting them. If you don't rely on doctors' reports, what other method can you rely on? Can you rely on your census? It seems from our experience in North Carolina that the census is not at all satisfactory, taken either by trained men or by local organizations. If you don't accept the doctors' reports, I don't know what reports you can accept. It is not up to us to question a doctor's diagnoses; we have got to accept them. He may be wrong in some instances, but a mistake in one direction will be offset by a mistake in the other direction.

Mr. LE PRINCE. There are two or three matters that have been brought to my attention. I have been asked by some one present if arrangements could not be made to thank the Engineers and Architect's Club for the use of this room, the Nassau County Mosquito Extermination Commission, of New York, for sending a representative here, and also the Agricultural Department for sending Mr. McCrory here. If this meets with your approval such letters of thanks will be sent. All in favor will please rise. I think I am authorized to send those letters forward.

Dr. FRICKS. Gentlemen, I am sorry I could not have been with you every minute of the entire time you had for your conference here in the last two days, but I had other matters in which you are also interested, which had to be attended to.

I am extremely proud of this meeting. I do not take any credit to myself for having brought it about; the credit belongs to you, to the cooperating agencies which made this meeting possible, and to your chairman, whom we believe to be the first man in malaria-control work in the United States [great applause], and who is certainly the first in the regard of us all.

Mr. LE PRINCE. This conference stands adjourned until 12 months, more or less, from to-day.

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LEAD POISONING IN THE POTTERY TRADES

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LEAD POISONING IN THE POTTERY TRADES.

PART I.

POTTERY REPORT.

INTRODUCTION.

REQUEST FOR A SURVEY.

In December, 1918, the Brotherhood of Operative Potters, through Mr. William Mushet, health officer of the brotherhood, requested an investigation to determine the prevalence of lead poisoning among dippers in the pottery industry. Dr. Francis D. Patterson, chief of the bureau of hygiene, Pennsylvania department of labor and industry, to whom the request was made, after conference with Mr. John Roach, chief of the bureau of hygiene and sanitation of the New Jersey department of labor (both field directors of the Office of Industrial Hygiene and Sanitation, U. S. P. H. S.), forwarded this request to the United States Public Health Service, with their indorsement that the Service undertake the survey, extending its scope to include all processes in the manufacture of pottery where the workers are exposed to a lead-poisoning hazard. This recommendation met with the approval of the Surgeon General, who acceded to the request and directed the Office of Industrial Hygiene and Sanitation to conduct the research required.

ALLEGED DISCRIMINATION AGAINST POTTERS DUE TO PREVIOUS SURVEYS.

Surveys had previously been made of the lead hazard in the pottery trades.[1] Analyses of vital statistics had also been made, with the result that a well-defined belief prevailed that certain pottery occupations are hazardous, and that dippers in particular are exposed, to a marked degree, to lead poisoning. As a result of these conclusions the Brotherhood of Operative Potters felt that dippers and some other pottery workers were unjustly discriminated against in the matter of obtaining life insurance. That there is a hesitancy among life insurance companies and fraternal societies to accept dippers as a safe risk is undoubtedly true. Frederick L. Hoffman,[2] Ph. D., vice-president of the Prudential Life Insurance Co., states: "As a general rule both life insurance companies and fraternal societies are extremely cautious in accepting risks on the lives of persons employed in at least the more health injurious processes of the pottery industry. Dippers, flint-mill workers, ground layers, mixers, scourers, and sweepers are generally declined unconditionally. Kilnmen, mold makers, placers, pug-mill workers, sagger makers, and slip makers are occasionally accepted, but at somewhat higher premium rates than those charged men in recognized healthy employments." Believing that denial to certain potters of the right to obtain life insurance is due to misunderstanding of the hazards of their trade as prevalent to-day, the Brotherhood of Operative Potters made this request for an impartial survey.

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[1] Lead Poisoning in Potteries, Tire Works, and Porcelain Enameled Sanitary Ware Factories, Bulletin of the U. S. Bureau of Labor Statistics No. 104, by Alice Hamilton.

[2] Mortality from Respiratory Diseases in Dusty Trades, Bulletin No. 231, pp. 265-266, Bureau of Labor Statistics.

RESULTS OF PREVIOUS SURVEYS.

It will be recalled that the two previous surveys of importance in this field in the United States showed a high rate of plumbism. One of these was made by Dr. Alice Hamilton in 1910 and 1911 and the other by Dr. Emery R. Hayhurst in 1914. Dr. Hamilton's survey included 68 plants in the States of New Jersey, Ohio, West Virginia, Kentucky, Tennessee, Indiana, Illinois, Wisconsin, and Pennsylvania, while Dr. Hayhurst made a survey of 47 plants in the State of Ohio.

Both these investigations covered plants making white ware; yellow, art, and utility ware; tile; and porcelain enameled sanitary ware. The survey by Dr. Hamilton might be called a period survey, the number of cases of lead poisoning over a period of two years being listed; while Dr. Hayhurst's survey might be called a cross-section study, there being listed the number of cases found when the plants were investigated.

Dr. Hamilton covered such points as methods of handling lead glaze; the extent to which workers are exposed; the precautions taken to prevent poisoning; a study of the workers themselves—their living conditions, their nationality, the character of their work, and the extent of industrial lead poisoning among them.

Dr. Hayhurst emphasized plant conditions as found, and made a comparison of the various conditions.

Dr. Hamilton obtained her list of cases of lead poisoning from four sources, namely, from physicians practicing in the towns where the plants were located, from hospital records, from cases discovered by physical examination of certain pottery workers, and from the history obtained from workers, of their own attacks of lead poisoning, with hearsay evidence of cases they had known among their fellow workmen. Dr. Hayhurst gives the number of cases found at the time of making investigations of plants. Unfortunately, there was included in this list a number of cases of absent workers, not seen by examining physicians, but alleged by fellow workers to be complaining of symptoms of plumbism.

Dr. Hamilton found 87 cases of lead poisoning among 1,100 men in a year and 57 cases among 393 women. Of 148 enamelers and mill hands examined, 54, or 36 per cent, were found by Dr. Hamilton to be suffering from chronic lead poisoning. Dr. Hayhurst reports that of 2,585 persons exposed, 109 were found to be suffering from lead poisoning. It is interesting to note that our investigators found 40 out of 50 of the above 109 cases still suffering from lead poisoning. Of the remaining 59 cases, our men procured information for about 24. Five of these had died of some unstated cause, 2 were employed in a pottery where lead is said not to be used, and the remainder were found to be insurance agents, farmers, teamsters, and foundrymen.

These two surveys clearly demonstrate the presence of lead poisoning among pottery workers, and both Drs. Hamilton and Hayhurst pointed out defects found in working conditions and made suggestions and recommendations which, if applied, would reduce the number of cases of lead poisoning.

For obvious reasons, since these two previous studies have been made in the pottery field of the United States, and because of the motive underlying the request for this particular study, the results of this research have not been compared with rate of plumbism found in foreign potteries. The main point here is whether, in a field where previous work has been done and definite recommendations have been made, and where the industry has been developing to supply home trade, and during a period of definite growth in plant hygiene and sanitation, the improvement in industrial hygiene and sanitation has been such as to reduce or eliminate the hazard of plumbism.

SURVEY DECIDED UPON.

In view of the fact that almost a decade has passed since Dr. Hamilton's survey in this field was made, and that during this time industrial hygiene and sanitation have made rapid progress in industrial establishments in general, the United States Public Health Service felt the necessity of making a more comprehensive survey as to the prevalence of lead poisoning among workers in exposed processes in the pottery industry.

SURVEY PERSONNEL.

Three districts of the Office of Industrial Hygiene and Sanitation, working under the close supervision of the research branch, participated in the survey, and the following personnel was employed for varying periods of service·

Philadelphia district:
  Passed Asst. Surg. (R.) Paul M. Holmes, director.
  Scientific Assistant Philip G. Kitchen, M. D.
  Scientific Assistant Eloise Meek, M. D., Dr. P. H.
  Scientific Assistant Myron A. Bantrell.
  Scientific Assistant E. N. Riley.
  Scientific Assistant C. A. Ward.
  Scientific Assistant George E. McElroy.
Pittsburgh district:
  Associate Sanitary Engineer (R.) G. E. P. Wright, director.
  Scientific Assistant Eli A. Miller, M. D.
  Scientific Assistant Harry C. Angermyer.
  Scientific Assistant E. Paul Raiford.
Cleveland district:
  Associate Sanitarian (R.) N. P. Bryan, director.
  Asst. Surg. (R.) Marvin D. Shie, M. D.
  Scientific Assistant Edythe M. Bacon, M. D.
  Scientific Assistant Walter H. Harris.
  Scientific Assistant Howard K. Thompson.
Dust analyses were made by—
  Chemist Edward L. Helwig.
  Scientific Assistant George H. Birch.
  Chemist Harry W. Houghton.

In addition, the research was directed in the Washington office by Passed Asst. Surg. A. J. Lanza and Sanitarian Bernard J. Newman (Reserve), with the assistance—toward the close of the study—of Passed Asst. Surgs. (Reserve) Wm. J. McConnell and O. M. Spencer in checking up the accuracy of the diagnosis; and Frank M. Phillips, statistician, in analysis of the data collected.

COOPERATION.

Throughout the survey the most cordial cooperation was received from the plant managers, from the members of the Brotherhood of Operative Potters, and from the pottery workers themselves. The extent of this cooperation is shown by the relatively high percentage of physical examinations made among the total number of employees engaged in the hazardous processes. With scarcely an exception, both owners and workers, including time and piece workers, seemed eager to promote a comprehensive and fair study of the alleged hazards.

CONFIDENTIAL DATA.

In all contacts made with the plants, as well as with the workers, the point was emphasized that information obtained would be considered strictly confidential in so far as local identity of plant or worker was concerned. Thus the history of a physical examination would not be furnished to any other individual but the one personally and immediately concerned, while statements of plant conditions and recommendations based thereon would be supplied only to the plant management. All material collected about the physical condition of individual workers or of individual plants would, when embodied in this final report, be so employed as to lose the identity of the individual and of the plant. The reason for this attitude is evident. The Office of Industrial Hygiene and Sanitation has no authority in the law to act as factory inspectors. Its sole function is to discover industrial health hazards involved in the causation of specific disease of man, and to determine engineering and other prophylactic measures for the prevention or elimination of such hazards. In this particular survey the object was to determine the presence and extent of the alleged lead hazard in certain processes, and, if such alleged hazard proved to be real, to suggest methods for its control. With this end in view, reports on individual plants were submitted to the plant managements concerned, while each pottery worker whose physical examination disclosed symptoms of lead poisoning or of any other physical ailment or defect was given private consultation. His condition was made known to him, and he was advised to see a physician of his own choice. To each pottery worker examined instructions were given relative to measures of personal hygiene, which if observed would materially reduce the hazard of his occupation.

ACKNOWLEDGMENTS.

Acknowledgments for valuable assistance and counsel are due Dr. Alfred Stengel, consulting hygienist, U. S. P. H. S., and professor of medicine, University of Pennsylvania; R. R. Sayres, passed assistant surgeon, U. S. P. H. S., chief surgeon, Bureau of Mines; Dr. Emory R. Hayhurst, consulting hygienist, U. S. P. H. S., and professor of hygiene, Ohio State University; Dr. Francis D. Patterson, chief of the division of industrial hygiene, Pennsylvania Department of Labor and Industry; Mr. John Roach, chief of the bureau of hygiene and sanitation of the New Jersey Department of Labor; Mr. William Mushet, health officer of the National Brotherhood of Operative Potters; The Bureau of Mines, Pittsburgh, Pa.; the Hygienic Laboratory, U. S. P. H. S.; Mr. R. T. Stull, superintendent of the Ceramic Laboratory, United States Bureau of Mines, Columbus, Ohio; and Mr. N. P. Bryan, associate sanitarian (R.), U. S. P. H. S.

THE POTTERY INDUSTRY AND ITS IMPORTANCE.

POTTERY PRODUCTION IN THE UNITED STATES.

The pottery industry is one of the oldest industries in the United States. On a commercial basis, excluding aboriginal ware, pottery production dates from 1685, when Dr. Daniel Coxe, of London, established a white-ware pottery at Burlington, N. J. In 1744, about 24 years before Cooksworthy discovered a suitable clay for the manufacture of chinaware in England, china clay was imported to England from the United States by Edward Heylan and Thomas Frye.[3] America, therefore, at one time helped to supply England with china clay, a fact the reverse of what is true to-day.

THE INCREASE OF POTTERIES IN THE UNITED STATES AND THEIR DISTRIBUTION.

The United States census of 1850 reported 484 potteries engaged in the manufacture of various types of pottery products. The United States Geographical Survey of 1912 shows 4,628 operating establishments making pottery, brick, or tile products, of which number 434 plants were manufacturing pottery products exclusively. The distribution of these latter plants by States is not available.

The impression seems to prevail among pottery workers that improvements in working conditions and in operations for decreasing production costs are not of material importance because of the alleged fact that the pottery industry in the United States is bound to decline. The difficulties in securing clay without importation may have contributed to this belief.

Nevertheless the fact remains that in a period of little over 60 years there has been almost a thousand per cent increase in the number of potteries in the United States, while those plants manufacturing exclusively the type of ware covered by this survey almost equal in number to-day the total number of plants manufacturing all kinds of ware in 1850.

The 1914 Census of Manufacturers shows the following distribution of potteries by States:

TABLE A.—*Summary for industries: Comparative for the United States, by States for 1914.*

State.	Number of establishments.	Wage earners (average number).	State.	Number of establishments.	Wage earners (average number)
United States	350	26,705	New Jersey	50	5,225
			New York	16	1,691
Alabama	12	26	North Carolina	12	11
California	11	177	Ohio	99	11,096
Colorado	5	53	Pennsylvania	21	1,564
Georgia	14	32	South Carolina	5	10
Illinois	16	1,459	Tennessee	5	48
Indiana	9	770	Texas	11	46
Louisiana	3	24	West Virginia	15	3,339
Massachusetts	8	138	Wisconsin	3	8
Michigan	6	339	All other States	26	641
Missouri	3	8			

Although the potteries engaged in production of sanitary and like ware covered in this survey are widely distributed over 36 States, yet the majority of these plants are found in 13 States, while the States of New Jersey, Pennsylvania, Ohio, and West Virginia—those covered in this survey—have 52.7 per cent of the total number of plants of like character in the United States. It will thus be seen that the area of the survey embraces the more prominent centers of pottery producion.

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[3] Edward Atlee Barber: "Pottery and Porcelain in the United States."

NUMBER OF EMPLOYEES AND NATIONALITIES.

In a comparison of the number of employees engaged in the various manufacturing industries in the United States the pottery industry stands sixty-first.

POTTERY EMPLOYEES.

TABLE B.—*The number of persons employed in the pottery industry, by age periods and sex, not including brick, tile, terra-cotta, clay, or stone industries.*[1]

Age.	Number of employees.			Per cent of total number of employees.	
	Total.	Males.	Females.	Males.	Females.
10 to 13 years	63	47	16	0.16	0.05
14 to 15 years	898	520	378	1.76	1.28
16 to 20 years	5,965	3,783	2,182	12.81	7.39
21 to 44 years	17,687	14,966	2,721	50.69	9.22
45 years and over	4,913	4,562	351	15.45	1.19
Total	29,526	23,878	5,648	80.87	19.13

[1] Miscellaneous Publication, Series 21, Department of Commerce, 1915, p. 269.

The pottery industry is now very largely American manned, as shown by the following table quoted from the department of Commerce report, and by our own table, which will be found under the section on Field Survey. As noted by this table, 73.79 per cent of all pottery employees were born in the United States. The industry may therefore be considered as carried on in the main by workers familiar with American customs and able to understand the English language; and the hazards of their work are not intensified by lack of knowledge of English or lack of Americanization.

TABLE C.—*Persons 10 years of age and over employed in the pottery industry, not including brick, tile, terra-cotta, clay, or stone industries, in the United States in 1910.*[2]

Nativity and parentage.	Total.	Males.	Females.	Per cent of total.
Native white of native parentage	15,344	12,027	3,317	51.97
Native white of foreign or mixed parentage	6,444	4,887	1,557	21.82
Foreign-born white	7,090	6,486	604	24.01
Japanese and Chinese	171	5	166	.58
Negro	477	473	4	1.62
Total	29,526	23,878	5,648	100.00

[2] Miscellaneous series No. 21, Dept. of Commerce, 1915, p. 345.

According to the distribution of employees this survey covers also the States containing the larger plants in the pottery industry. Eighty and five-tenths per cent of all employees are employed in 87 plants. The remainder, or 19.5 per cent of the employees, are employed in 263 plants, while 52.6 per cent of the plants employ less than 20 people each.

TABLE D.—*Number of wage earners and per cent in each class for the 350 plants covered in the 1914 Census of Manufacturers.*[1]

	Number of establishments.	Number of employees.	Per cent of average number employed.
No employees	27	None.	
1-5 employees	99	232	0.9
6-20 employees	58	753	2.8
21-50 employees	40	1,454	5.4
50-100 employees	39	2,768	10.4
101-250 employees	62	10,377	38.9
251-500 employees	19	6,093	22.8
501-1,000 employees	5	3,800	14.2
Over 1,000 employees	1	1,228	4.6

[1] 1914 Census of Manufacturers, p. 418.

TABLE E.—*Production, capital invested, and value of products.*

[In establishing the importance of the pottery industry it is essential to show not only the number of employees but the value of the products. Such values are quoted from Miscellaneous Series No. 21, Bureau of Commerce, 1912, p. 73.]

States.	White ware.[1]	Stoneware, yellow, red, and Rockingham ware.	Chinaware.[2]	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.	Total.
Ohio	$9,969,491	$2,095,351		$451,971	$1,827,290	$1,164,632	$15,508,735
New Jersey	1,090,683	84,952	$1,155,766	5,199,278	1,146,467	258,774	8,935,920
West Virginia	2,051,987	([3])	50,002	1,156,478	([3])	36,444	3,365,166
New York	([3])	31,497	691,065	([3])	1,269,108	51,988	2,405,532
Pennsylvania	902,585	443,663	280,472	185,000	307,636	9,184	2,128,540
Indiana	([3])	46,100		633,578	([3])		1,077,102
Other States	814,685	2,176,485		275,950	376,815	268,787	3,083,169
Total	14,829,431	4,878,048	2,177,305	7,902,255	4,927,316	1,789,809	36,504,164

[1] White ware, including semiporcelain, white granite, china-clay ware, and semivitreous ware.
[2] China, bone china, delft, and belleek ware.
[3] Included in "Other States."

From an analysis of the foregoing tables it occurred to the investigators that if, on a survey of the larger plants, it was found that the industry did present to workers in selected occupations a definite exposure to lead compounds, with a resultant percentage of employees affected with plumbism, the hazards might be classed as normal trade hazards and should not be confused with those arising from abnormal working conditions found in small shops with limited facilities and a diversity of occupations carried on alternately by the same employee. The predominance of larger plants in the production of pottery ware is evident from Table D, showing

"Number of wage earners and per cent in each class for the 350 plants covered in the 1914 Census of Manufacturers." Moreover, the practicability of a reasonable control of plumbism among pottery workers in the United States is more certain because of the greater number of large plants with ample resources. Where large plants show a higher rate of plumbism than small plants, there is less excuse for the continuance of working conditions responsible in the main for such higher rates. Such plants, having larger resources and more continuous use for improvements, can better afford to install them. Were the industry one of small plants mainly, as assumed by many pottery manufacturers, there would be but small chance of the installation of devices to control its hazards. The table mentioned above and given on page 18 shows, however, that small plants play but a relatively insignificant part in the total distribution of pottery employees.

The States covered in this survey are among the five leading States in the production of pottery ware, and the total value of their products is approximately five-sixths of that of the entire production in the United States—Ohio producing a little over 42 per cent of the total output.

In 1914 the total capital invested in this industry was $44,704,000, the wages paid to employees were $16,666,000, and the cost of material was $12,032,000.[5]

The value of all domestic pottery marketed in 1918 was $65,222,951. Of this Ohio, the leading State, produced ware valued at $25,779,654, nearly 40 per cent of the value of the production in the United States; and of Ohio's production the white ware was valued at $15,779,620, 61 per cent of the entire State production. The first five States in order of the value of their productions are Ohio, New Jersey, West Virginia, New York, and Pennsylvania, with a total production valued at $56,534,495, nearly 87 per cent of the value of the total production of the United States. (U. S. Geographical Survey on "Pottery in 1918," p. 4.)

CONSUMPTION, EXPORTS, AND IMPORTS OF POTTERY IN THE UNITED STATES IN 1918.

CONSUMPTION.

The value of the pottery imported into the United States in 1918, added to that of the domestic pottery marketed, amounted to a total of $71,616,531. After deducting from this sum the value of the exports of domestic wares, approximately $1,479,552, and of the reexports of foreign ware, $70,099, the value of the apparent net consumption was $70,066,880, of which the domestic production was 93 per cent—the highest proportion recorded. In 1917 and 1916 it was 92 per cent. In 1915 this per cent was 86, in 1914 it was 82, in 1913 it was 80, in 1912 it was 81.45, in 1911 it was 78.93, and in 1910 it was 77.08. Here, again, it will be seen that in addition to the steady increase in the number of potteries there is an increase also in the percentage of home ware used in the United States. This is a situation which not only indicates the continued importance of the industry, but nullifies the argument so often met with during the survey—that the industry is declining, and hence would not justify any extended improvements for lessening the lead hazard.

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[5] Census of Manufactures, 1914, p. 202.

[6] U. S. Geographical Report on "Pottery in 1918," p. 12.

IMPORTS.

The total value of all clay products imported in 1918, at the port of shipment, was $6,684,200. Of this earthenware, crockery, china, and porcelain amounted to $6,370,530, the balance consisting of pipes, clay bowls, sanitary ware, bricks, and tile.

EXPORTS.

The value of the clay products of domestic manufacture exported from the United States in 1918 was $7,932,574, and these products were exported to the following countries in order of the value of exports: Canada, Central America, West Indies, South America, Mexico, Europe, Oceania, Newfoundland, and Africa.

CONCLUSIONS.

As shown by the table compiled from the official statistics of the principal foreign countries manufacturing pottery ware for the period between 1895 and 1913,[7] the United States is of all nations the heaviest importer of pottery products, importing over 100 per cent more pottery products in 1913 than France, our nearest competitor, yet our imports have not increased materially from 1895 to 1913. The total increase in 1913 over 1895 is $689,045, which is 7.6 per cent, as compared with an increase from 8 per cent to 1,141.66 per cent, of 12 other leading countries in the world. This increase in imports does not correspond with the population increase of 36 per cent for the same period, which fact not only shows that our own pottery products are approaching our needs more nearly than in the past, but also indicates a permanency of the industry, which warrants serious consideration of the character of its health hazards and of means to minimize them. This conclusion is further strengthened when it is recalled that our exports are on the increase, a gain of 1,432.34 per cent having been made in 1913 over 1895.

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[7] Pottery Industry, Miscellaneous Series No. 21, p. 645, Department of Commerce.

The increase in percentage of exports and the decrease in percentage of imports are purposely omitted here because of the interference in any accurate interpretation of the trend of the industry, due to the abnormal trade relations caused by war.

The problem of the industry is not, as potters frequently express it, one of a declining trade which ultimately will cease to be a factor in the industrial world, but rather of a growing industry, to lessen the production cost of which requires thought in terms of labor-saving devices and working conditions from which unnecessary health hazards have been removed.

ORGANIZATIONS AND PUBLICATIONS.

Social and industrial progress follows the dissemination of ideas among groups held together by common interest. It is gratifying to note that the pottery industry is well organized into groups of like kind, which hold meetings and publish trade journals, and thus afford vehicles for the dissemination of ideas concerning all phases of production of interest to pottery manufacturers or pottery workers.

The American Ceramic Society, the object of which is to promote the arts and sciences connected with ceramics by means of meetings for the reading and discussion of professional papers, for the publication of professional literature, and for social intercourse, is the largest and most cosmopolitan organization among pottery manufacturers. The United States Potters' Association is an organization of potters manufacturing vitreous china, sanitary ware, and earthenware. It has been in existence for 36 years, and its general objects are "to procure regularly the statistics of the trade, both at home and abroad; to provide for the mutual interchange of experience, both scientific and practical; to collect and distribute all information relating to the various branches of our arts, and to take such means as will devise theoretical and practical information to our trade in all its branches."

The publications circulated among manufacturers are the Journal of the American Ceramic Society and the American Potters' Gazette.

Among pottery employees the National Brotherhood of Operative Potters, which is affiliated with the American Federation of Labor, is the chief organization. This society is composed entirely of pottery employees, and is the final perfected organization of various unions in existence among the potters prior to 1890. It has grown from a membership of 200 to its present size of 8,870 members. The National Brotherhood of Operative Potters has a death-benefit system of insurance and a tuberculosis fund.

The principal publication of employees is The Potters' Herald, which is published by the National Brotherhood of Operative Potters. There are several plants that have local health and sick-benefit associations, as well as publications for the mutual advantage of employers and employees.

The National Brotherhood of Operative Potters and the United States Potters' Association settle all questions arising between manufacturers and employees, and because of this arrangement the pottery industry has not for a long period been troubled by any serious strikes or labor disturbances.

The advantages gained in recent years by employers and employees through their organizations have been many—a few of which are the establishment of uniform piecework prices and of a system of collective bargaining, the continuance of work while grievances are being adjusted, the regulation of the working day, and the prevention of unwarranted strikes.

Both manufacturers and workers are provided with means through organization, meetings, periodicals, and joint relations, for cooperation to eliminate any and all occupational health hazards arising within the industry.

SCOPE AND TECHNIQUE OF THE SURVEY.

WHERE MADE—IN WHAT STATES.

Representative potteries of New Jersey, Ohio, Pennsylvania, and West Virginia are included in the survey. The total number studied is 92—24 in New Jersey, 47 in Ohio, 8 in Pennsylvania, and 13 in West Virginia. Two additional plants in New Jersey were superficially studied, but are not included in this report, because the manager of one of them refused permission for a comprehensive survey and the other was undergoing reconstruction, so that a complete survey was impracticable.

For administration purposes the work was divided into districts—the Pittsburgh district, with 30 potteries; the Cleveland, with 38; and the Trenton, with 24. The potteries, however, came largely within two definite trade areas, one known as the East Liverpool district, with 30 plants, and the other as the Trenton, with 24. There were 38 other potteries scattered outside these trade districts.

ATTITUDE OF PLANTS TOWARD THE SURVEY.

In a preliminary survey to determine the attitude of the pottery manufacturers toward the prospective study of a lead hazard in the industry, letters were sent to 54 plants, stating the purpose and plan of the survey and soliciting information as to the use of lead compounds in preparing glaze. Replies were received from 31 plants, of whom 27 expressed a willingness to cooperate. It appeared, therefore, that the attitude of the trade would be favorable to the study. Throughout the period of the survey this favorable attitude was uniformly found among both the plant owners and their employees.

After the selection of districts, service officers were detailed to make personal contacts with the plant managers to arrange for a formal entry into the various plants, for sanitary examination of personal service facilities, workrooms, and practices of employees, as exhibited in the various processes of production. Similar arrangments were made with the plants and the employees, for the physical examination of men and women exposed to a lead hazard.

COORDINATION OF FIELD INVESTIGATIONS.

Field investigations were begun in January, 1919, and were continued until August, 1919, save in a few instances where the necessary data pertaining to specific plants could not be secured until later.

The survey includes 21 plants making sanitary ware; 59, general ware; 4, tile; 4, yellow; and 4, art.

According to number of employees the sizes of the plants vary as follows:

Number of employees.	Number of potteries.
0- 50	5
51-100	14
101-250	55
251-500	14
500 plus	4

SCOPE OF TECHNIQUE.

The above tables show us that this survey includes plants of all sizes and a large number of plants of the most frequent size, as indicated in our tables on page 17, under "The Pottery Industry and its Importance." Therefore our selection is representative of the pottery industry of the United States as far as size is concerned.

Physical examinations were made of 1,809 workers out of a total of 1,902 engaged in the glaze departments of plants employing a total of 17,297 workers. Of these workers 1,436 are men and 373 women. Plant sanitation was investigated at the time of making the physical examinations. Dust samples were taken at various places of employment and in the line of travel in each department. These samples were analyzed for per cent of lead, for per cent of soluble lead, for dust count, and for weight. Samples of glaze mixture were also analyzed for per cent of lead and per cent of soluble lead.

QUALIFICATIONS OF PERSONNEL.

Great care was exercised in selecting the investigators. It was felt that routine investigations would not yield satisfactory results, and that although a comprehensive schedule was adopted, as will be indicated later, yet the investigators should be conversant with industrial processes and especially with the factors involved in the maintenance of health, or, in other words, with the factors that are capable of endangering health. With this end in view the investigators assigned to the physical examination of plants were chosen because of their technical training and were mainly men trained in chemical or sanitary engineering or experienced in public-health research work.

The medical officers assigned to the physical examinations of employees were all acting assistant surgeons of the United States Public Health Service, experienced in industrial hygiene and conversant with the effects of lead compounds upon the body. Women physicians were employed for the physical examination of women workers. In order to coordinate the work of the physicians, conferences were held at which the characteristic symptoms of lead poisoning were discussed and a uniform method of diagnosing plumbism was agreed upon. Throughout the period of the survey there was a close interchange of information among the members of the field force. Wherever deviations from agreed technique were made, records of such deviations were interchanged.

Close supervision of the work of the medical officers in making physical examinations was maintained by Dr. A. J. Lanza, in charge of the Office of Industrial Hygiene and Sanitation at that time, while similar supervision was given by field directors, working under Sanitarian Bernard J. Newman (R.), to the work of the engineers in the physical examinations of the plants and the determination of engineering, sanitary, and hygienic conditions.

SCHEDULES.

In order to assure the collection of pertinent data, a comprehensive schedule was prepared and used by all field workers. This schedule covers in detail all phases of plant conditions and of plant management that might have a bearing in the final analysis of the extent to which plant working conditions contributed to the occurrence of lead poisoning.

It was felt that data pertaining to plant management should picture the provisions made for supervision of workers as to personal practices and personal hygiene, since such matters affect the control or the incitation of the hazards of their employment. Hence personnel problems, medical supervision, health education, welfare work, housing, and like items were noted on the survey forms. To secure a picture of working conditions and of possible sources of health hazards, process analyses were made; and to facilitate the isolation of practices which might explain the greater or lesser prevalence of lead poisoning among potteries, plant physical conditions and the methods used by employees in pursuing their operations were correlated. Predisposing factors were included, such as fatigue, poor light, poor ventilation, uncleanliness, excessive heat or cold, inadequate or imperfect personal-service facilities, or their insanitary use. Each of these topics was subdivided in great detail. In addition, engineering practices to facilitate hygienic working conditions and to eliminate possible sources of infection were carefully noted. The schedule was elastic in that the engineers using it were instructed that it was to serve as a guide to help standardize the type of data from the various plants, as collected by many investigators, and that it was to be suggestive also of the new factors, which, if noted, were to be numbered and explained in full detail on the reverse side of the form.

A similar careful preparation was made of the form for noting the information obtained by the medical officers in their physical examination of employees. A standard schedule was also adopted here, to be supplemented by additional data as required by the physical condition of the workers examined. It was not deemed necessary to make a detailed examination of the workers further than to obtain information in regard to the subjects listed in the following outline:

Name.
Address.
Age.
Sex.
Nationality.
Occupation.
Process.
Location.
Time in present work.
Other occupations—time in each.
Hazards—dust, heat, poisons.
Light, vibrations.
Work:
  Time.
  Piece.
Hours of work.
Lunch:
  Time.
  Place.
Father's chief occupation.
Mother's chief occupation.
Maximum weight.
Weight after 3 months at present work.
Weight now.
Height.
Chief complaint, if any (in patient's words).
History of present illness from first symptom.
Social history (personal habits).
Past history from infancy (include menstrual and maternity).
Temperature. Pulse.
Build. Anasarca.
Emaciation.
Posture. Lordosis.
Gait. Kyphosis.
Glands—enlarged.
Skin:
  Color.
  Jaundice.
  Eruptions.
  Ulcers.
Arteriosclerosis.
Blood pressure.

Objective findings.

Well-nourished condition.
Color. Development.
Age. Apparent age.
Facial expression.
Evidence of paralysis.
Tremors.
Tongue.
Fingers.
Strabismus.
Eye:
  Vision (R) (L).
  Ptosis.
  Pupils.
  Disease.
Condition of teeth.
Lead line.
Tongue—coated.
Hearing.
Neck.
Children.
Chest—tender areas.
Heart.
Lungs.
Abdomen.
Eyes:
  Disease.
  Movements.
  Trachoma.
  Tremor (of lids).
  Exophthalmos.
  Pupil reactions.
  Cataract.
  Blindness.
  Vision (Snellen test, distance 20 feet).
  Right.
  Left.
Sense of smell (asafetida and peppermint):
  Sharp.
  Dull.
Nose diseased.
Lips:
  Color.
  Disease.

Objective findings—Continued.

Teeth:
- Condition.
- Occlusion.
- Absent (number).

Subjective history.

Headache.
Malaise.
Nausea—when.
Appetite—metallic taste.
Tongue—coated.
Abdominal pain (colic).
Constipation. Diarrhea.
Weight now. One year ago.
Neuralgic pains.
In muscles. Joints.
Lumbago.
Muscles—sore.
Prickling, burning, numbness in extremities.
Mental symptoms.
Eyesight.
Menstrual history.
Rigidity.

Subjective history—Continued.

Tenderness:
- Tumors.
- Enlarged liver.
- Other abnormalities.

Extremities:
- Wrist drop.
- Shoulder drop.
- Other paralysis.
- Muscular weakness.
- Grip (by dynamometer).

Neuritis.
Joints (inflammation).
Joints—swollen.
Contractures.

Reflexes:
- Knee.
- Biceps.
- Ankle clonus.

Blood examination.

Haemoglobin.
Microscopic.
Basophilic granulation.

All findings of physical examinations were noted at the time of the examination except such data as were determined by laboratory work. Physical examinations were made in the plant except where it was inconvenient for workers to be examined during the working period, in which event arrangements were made to have them attend temporary clinics. This was especially the case in the Trenton district, where a clinic was opened in the post-office buildings and workers appeared there for examination. After the purpose of the survey was understood and certain employees were advised of physical defects with which they had not been acquainted there was an evident willingness on their part to supply all information called for and to assist in securing accurate data.

MEASURING INSTRUMENTS AND METHODS OF COLLECTING SAMPLES.

The measuring instruments used in the survey were the anemometer, the sling psychrometer, and the Palmer water-spray dust machine to determine the air flow of exhaust systems, the temperature, and the relative humidity, and to collect dust samples for analysis, respectively. The anemometer was of the zero-setting attachment type, with four dials reading to 100,000 feet, the air current being determined by multiplying the velocity by the area of the fan chamber. The sling psychrometer consists of two thermometers whirled upon a handle, the bulb of the longer thermometer being covered with a cloth which was moistened with water before the instrument was put in motion. After whirling the thermometers for a few seconds, the readings of each were taken. This process was duplicated several times, until the values became constant. Relative humidities were computed from psychrometric tables of the Weather Bureau.[8]

Air sampling made with the Palmer water-spray dust machine followed the technique recommended by the committee on standard methods of the examination of air, American Public Health Association.[9] The machine works by the principle of suction, which is furnished by a motor-driven aspirator. A column of air is drawn through a quantity of distilled water, about 40 c. c., at a uniform rate, varying from 1 to 6 cubic feet of air a minute. This process is kept up for definite periods of time, which in the survey averaged about 35 minutes. The air thus filtered through the water represents in volume approximately that breathed by a man during eight hours of moderate labor. While the Palmer machine does not collect an air sample that is comparable with air conditions as they vary during the working day period, yet it approximates, among other devices on the market for air sampling, a standard test of air dustiness at a given place and for a given period during which it is in operation. According to the committee on ventilation of the American Public Health Association, the rate of efficiency of this instrument is about 60 per cent. Thus the dust counts given on the basis of the air samples collected may be interpreted as being less in quantity than the actual dust content of the air of the work places at the time of collecting the samples.

In an attempt to show the amount of lead which a man would take into his nostrils during the entire working day, some experiments were made with the "Dustite respirator." The principle upon which this respirator works is that of filtering air through a collecting gauze, the surface of which is at such an angle as to prevent settling of dust other than that drawn in by breathing. This respirator was adjusted to individual faces, and an allowance of 5 per cent was made for leakage. Workers volunteered to wear the apparatus for continuous periods. By placing the respirator on a number of workers in the same occupation, an average was obtained for the group for the entire working day. Samples thus collected were analyzed in the same manner as were those collected by the Palmer machine.

TECHNIQUE OF DUST ANALYSIS.

DUST WEIGHT.

The dust samples collected by the Palmer machine were transferred in the field to clean 100 c. c. volumetric flasks, the original containers being thoroughly rinsed with distilled water, sufficient in quantity to bring the total sample up to 100 c. c. These samples were then sent to the laboratory for examination. In the laboratory the flasks were thoroughly shaken, and two 1 c. c. portions of the solution were removed for the dust count. The remainder of each sample was filtered through a carefully prepared Gooch asbestos filter previously dried at 100° C. and weighed. The residue of dust was carefully washed with cold distilled water, dried at 110° C. for one hour, and weighed. The total weight of dust obtained was corrected for the amount of sample previously removed for the dust count. In case 2 c. c. were removed, 2.04 per cent of the weight of dust obtained was added to obtain the weight of dust in the original sample.

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[8] W. B. No. 235, U. S. Dept. Agriculture.

[9] The American Journal of Public Health. Vol. VII, 1917.

DUST COUNT.

The 2 c. c. removed from the sample for the dust count were placed in Sedgwick-Rafter cells. Two counts were made of each. Typical squares were selected and counts were made, the average of which was taken as the dust count of the sample. The magnification used was such that with the eyepiece micrometer each square approximated one standard unit. Dust counts were made and distributed, according to methods adopted in the dust analysis work of the United States Public Health Service, into groups 1, 2, 3, 4, and 5. Such groups were expressed according to size and according to standard units as follows:

Group.	Standard units.	Size per square millimeter.
1	100	0.04
2	25	0.01
3	1	0.0004
4	000.25	0.0001
5	Fine dust particles below one-fourth standard unit in size	

DETERMINATION OF LEAD.

Soluble lead.—Soluble lead was determined by the following method: 0.15 gram of the dry sample was weighed in duplicate into a glass-stoppered bottle, and after 150 c. c. of 0.25 per cent hydrochloric acid were added shaken for one hour in a shaking machine at a rate of 200 excursions a minute. The contents of bottle were transferred to a 200 c. c. volumetric flask and diluted to mark with water. After one hour of standing the sample was filtered and 100 c. c. aliquot were transferred to a 300 c. c. Erlenmeyer flask. Two c. c. of N/5 acetic acid were added, saturated with hydrogen sulphide and allowed to stand over night under a bell jar. The entire precipitate was filtered and transferred with the aid of the first filtrate. The precipitate was washed six times with 10 c. c. portions of a solution of H_2S, 100 c. c. of water, and 5 c. c. of N/5 acetic acid. The filter containing the precipitate was then returned to the original Erlenmeyer flask and 2 c. c. of 1–10 HNO_3 were added. A funnel was placed in the mouth of the flask, and the contents were boiled moderately for five minutes.

After being filtered the residue was washed six times with about 10 c. c. each of hot water, and the filtrate was evaporated on a steam bath to about 10 c. c. When cool, 5 c. c. of concentrated sulphuric acid were added and heated until copious SO_3 fumes were given off. When cool, it was diluted with 5 c. c. of water, 150 c. c. of 50 per cent alcohol were added, and the mixture was allowed to stand over night. After being filtered through a tarred Gooch crucible it was washed six times, the crucible being filled each time with 50 per cent alcohol. The final washing was done with 10 c. c. of 95 per cent alcohol. The crucible and the lead sulphate were dried two and one-half hours at 100° C. and weighed. The increased weight of the crucible was the lead sulphate. Using the factor 0.6832, the per cent of soluble lead in the sample was calculated.

Total lead.—One gram of the dried sample was weighed into a 100 c. c. casserole, 30 c. c. of 1–1 nitric acid was added and evaporated to dryness on a steam bath. The residue was then taken up with hot water and filtered and the resulting residue was washed on filter paper with hot water. Filtrate was reserved for combination with filtrate from fusion of residue. Residue and filter paper were transferred to a platinum crucible, dried, and ignited until paper was nearly ashed. Four grams of fusion mixture (5 parts Na_2Co_3 and 7 parts K_2CO_3) were added to residue in crucible and fused until fusion was complete. The crucible was removed to casserole, and the fused sample was dissolved in a weak aqueous solution of HCl until crucible was clean. The resulting solution was filtered and residue washed on filter paper until free of solids. The filtrate was combined with the above filtrate and the combined filtrate was evaporated and transferred to a 200 c. c. volumetric flask. It was diluted to mark and mixed thoroughly. Two 40 c. c. aliquots were evaporated to dryness in 200 c. c. casserole. Thirty c. c. of 1–1 HNO_3 were added and evaporated to dryness again, then taken up with hot water and transferred to 300 c. c. Erlenmeyer flask and diluted to 100 c. c. mark. Five c. c. of N/5 acetic acid were added, saturated with H_2S, and allowed to stand over night under bell jar. The lead sulphide was filtered, and the same process as that for the determination of soluble lead was followed, weighing the lead sulphate and calculating the per cent of total in the sample.

GLAZE SAMPLES.

One hundred and seven glaze samples were collected in all from 92 plants. Our investigators failed to get glaze from five of the plants. One of the number was destroyed by fire before the glaze could be secured, one became bankrupt, and those who took over the plant used a new glaze. Another, while not refusing the glaze, delayed furnishing it until too late to be used in this survey, and two plants refused to furnish samples of glaze for analysis.

Some of the plants used more than one kind of glaze, so that 87 plants furnished the total of 107 samples. These samples were analyzed, some by our own chemists and the remainder by chemists in the Bureau of Mines. The per cent of total lead and the per cent of soluble lead in the dry glaze are those used in this study.

RESEARCHES OUTSIDE THE PLANT.

Attempt was made to obtain supplementary evidence by consulting the records of the hospitals and those of the Brotherhood of Operative Potters. From the former very little information could be obtained. Apparently local physicians either did not recognize plumbism among their patients or were not consulted by them after symptoms of lead poisoning had developed. Table No. 1 gives the result of the study of the records of the Brotherhood of Operative Potters. It will be seen that the causes of death there given are in general terms only. A presumption as to the real cause of death would be the only means of approximating the fatalities from lead poisoning. Literature was also consulted, such as that published by the Division of Vital Statistics of the United States Census Bureau. Records thus obtained were for one year only. Other sources of information are the life-insurance companies and fraternal societies. Records from these sources were found to have a limited value on account of the shortness of the time for which they were kept. From a study of available mortality statistics the only conclusion that can be drawn is that in giving the cause of death the attending physician too seldom makes a diagnosis of plumbism. Tables II *a* and *b* give deaths of pottery workers by age groups.

Visits were made to the homes of the workers, but the information obtained there being decidedly of a secondary character, while interesting, could not be incorporated in a scientific analysis of the occurrence of lead poisoning.

TABLE I.—*Cause of death among potters as shown by reports of National Brotherhood of Potters, 1911–1919.*

Cause and percentage of deaths among potters, 1911–Apr. 30, 1920, inclusive.	Tuberculosis.	Other respiratory diseases.	Heart d'sease.	Nervous circulatory diseases.	Paralysis.	Paresis.	Complication.	Bright's disease.	Liver-kidney.	Digestive.	Accident.	Miscellaneous.	Contagious infections.	Total.
1911	5	4	......	......	1	......	......	1	5	2	1	1	......	20
1912	16	6	3	......	1	......	6	7	......	......	1	3	2	45
1913	13	5	5	1	3	......	2	1	4	4	3	1	2	44
1914	9	4	2	1	4	......	1	1	5	......	1	4	1	33
1915	26	12	9	......	3	1	3	2	5	2	2	8	......	73
1916	20	8	10	5	1	1	4	3	4	3	2	20	......	81
1917	25	14	5	3	2	......	7	......	3	4	1	12	......	76
1918	30	20	8	4	1	1	4	1	8	1	7	17	......	102
1919	16	80	4	3	......	......	9	3	3	1	15	8	......	142
1920	21	28	3	7	1	......	5	5	2	3	8	8	1	92
Total....	181	181	49	24	17	3	41	24	39	20	41	82	6	708
Yearly average.	18.1	18.1	4.9	2.4	1.7	0.3	4.1	2.4	3.9	2.0	4.1	8.2	0.6	70.8
Per cent of total	25.6	25.6	6.9	3.4	2.4	4.2	5.8	3.4	5.5	2.8	5.8	11.6	.85	100

TABLE IIa.—*Age of death among potters, 1911–1919.*[1]

Age (years).	Tuberculosis.	Other respiratory diseases.	Heart disease.	Nervous circulatory diseases.	Paralysis.	Paresis.	Complication.	Bright's disease.	Liver-kidney.	Digestive.	Accident.	Miscellaneous.	Contagious infections.	Total.
15-24	6	12	1	......	......	......	......	......	3	1	6	8	......	37
25-34	38	40	7	1	......	......	......	2	4	4	9	18	1	124
35-44	36	31	11	3	1	2	9	4	6	2	9	15	3	132
45-54	56	31	9	3	6	......	12	6	15	5	9	15	......	167
55-64	15	28	10	7	7	1	11	4	7	3	......	11	......	104
65 and over	4	6	5	3	1	......	4	2	2	......	......	2	......	29
Not stated	5	5	3	......	1	......	......	1	......	2	......	5	1	23

[1] Age of 1920 not given.

TABLE IIb.—*Per cent of age groups shown in Table IIa.*

Age (years).	Tuberculosis.	Other respiratory diseases.	Heart disease.	Nervous circulatory diseases.	Paralysis.	Paresis.	Complication.	Bright's disease.	Liver-kidney.	Digestive.	Accident.	Miscellaneous.	Contagious infections.	Total.
15-24	16.2	32.4	2.7	......	......	......	......	......	8.1	2.7	16.2	21.6	......	100
25-34	30.6	32.3	5.6	0.8	......	......	......	1.6	3.2	3.2	7.3	14.5	0.8	100
35-44	27.3	23.5	8.3	2.3	0.8	1.5	6.8	3	4.5	1.3	6.8	11.3	2.3	100
45-54	33.5	18.6	5.3	1.8	3.6	......	7.2	3.6	9	3	5.3	9	......	00
55-64	14.4	26.9	9.6	6.7	6.7	.96	10.6	3.8	6.7	2.9	......	10.6	......	100
65 and over	13.8	20.7	17.2	10.3	3.5	......	13.8	6.9	6.9	......	......	6.9	......	100
Not stated	21.7	21.7	13	......	4.3	......	......	4.3	......	8.7	......	21.7	4.3	100

PART II.

FIELD SURVEY.

POTTERY EMPLOYEES.

NUMBER AND PER CENT OF TOTAL POTTERY WORKERS REPRESENTING EXPOSED GROUPS.

In the 92 plants surveyed the total number of workers employed is 17,297, 12,558 being males and 4,739 females. However, only 1,504 males, or 11.9 per cent, and 398 females, or 8.4 per cent, were found to be exposed to the lead hazard. Of the number exposed only 68 males and 25 females were absent or unwilling to take the time to submit to a physical examination.

AGE.

The grouping of the pottery employees into age groups according to occupations and sexes and percentage distribution of each group is shown in Table III.

Of the total number of men exposed to the lead hazard, which is 1,436, it is seen that 108 are under 20 years of age, and 110 women of the total number of 373 are under 20. The largest number of males in this group are employed as dippers' helpers and ware carriers, while the females of the group are chiefly dippers' helpers, ware gatherers, and cleaners. In the age group of 60 plus there are 80 men, 21 of whom, representing the largest group, are employed as glost-kiln placers. The four women in this group are employed as ware cleaners. The largest number of males are found between the ages of 30 and 49, comprising 761 of the total. Of this group those between 35 and 39 number 220, or 15.4 per cent of the entire number. This is not true of the female group. It is seen that the largest number of females is found in the group under 20 years. In this group there are 110, or 29.4 per cent, of the total number of 373. The number in the successive age groups diminishes until the age group of 45 to 49 is reached, where there is a slight rise, and after the age of 50 there is a marked diminution.

The men are largely employed as glost-kiln placers and dippers. Thus, of the 1,436 men exposed 974 are employed in these two occupations. The women are largely employed as dippers' helpers and ware cleaners. There are 149 in the former and 95 in the latter group.

TABLE III.—*Age groups, by occupations and sexes, and percentage distribution of each group of pottery workers.*

MEN.

Occupation.	Age frequencies.											Per cent of age group.									
	Under 20.	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60 plus.	Total.	Under 20.	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60 plus.
Foreman	......	1	2	2	5	8	7	7	6	1	39	......	2.6	5.1	5.1	12.8	20.5	17.9	17.9	15.4	2.6
Glaze mixer	8	7	4	10	13	14	18	14	13	11	112	7.1	6.2	3.6	8.9	11.6	12.5	16.1	12.5	11.6	9.2
Dipper	8	29	35	39	49	32	25	21	17	12	267	3.0	10.9	13.1	14.6	18.3	11.9	9.0	8.0	6.3	4.5
Dipper's helper	35	10	5	5	6	4	2	2	1	1	71	49.3	14.1	7.1	7.1	8.4	5.6	2.8	2.8	1.4	1.4
Ware carrier	32	3	4	4	3	2	1	2	2	5	58	55.2	5.2	6.9	6.9	5.2	3.4	1.7	3.4	3.4	8.6
Ware cleaner	5	2	1	......	......	1	......	......	......	......	9	55.5	22.2	11.1	......	......	11.1	......	......	......	......
Glost-kiln placer	14	44	93	109	121	126	76	65	38	21	707	1.9	6.2	13.1	15.4	17.1	17.8	10.7	9.2	5.4	3.0
Kiln fireman	......	......	......	......	......	4	1	5	1	1	12	......	......	......	......	......	33.3	8.3	41.6	8.3	8.3
Kiln drawer	......	2	1	2	......	......	......	1	......	......	6	......	33.3	16.7	33.3	......	......	......	15.7	......	......
Oddman	2	2	6	8	11	9	7	5	8	11	69	3.0	3.0	8.7	11.6	15.9	13.0	10.1	7.2	11.6	15.9
Sagger washer	3	6	5	6	9	11	4	7	5	17	73	4.1	8.2	6.9	8.2	12.3	15.1	5.5	9.6	6.9	23.3
Decorator	1	1	2	2	3	2	......	2	......	......	13	7.7	7.7	14.6	14.6	23.1	14.6	......	14.6	......	......
Total	108	107	158	187	220	213	141	131	91	80	1,436	7.5	7.4	11.0	13.0	15.4	14.9	9.8	9.1	6.3	5.6

WOMEN.

Occupation.	Under 20.	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60 plus.	Total.	Under 20.	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60 plus.
Forewoman	......	1	......	3	2	......	3	1	......	......	10	......	10.0	......	30.0	20.0	......	30.0	10.0	......	......
Dipper	1	7	4	4	1	2	2	2	2	......	25	4.0	28.0	16.0	16.0	4.0	8.0	8.0	8.0	8.0	......
Dipper's helper	47	39	21	15	10	4	11	2	......	......	149	31.6	26.3	14.1	10.1	6.7	2.6	6.8	1.4	......	......
Ware carrier	25	11	9	3	2	3	6	2	1	......	62	40.3	17.7	14.5	4.8	3.2	4.8	9.7	3.2	1.6	......
Ware cleaner	30	9	13	7	5	7	8	7	5	4	95	31.6	9.5	13.7	7.4	5.3	7.4	8.4	7.4	5.3	4.2
Kiln drawer	......	1	2	2	3	4	1	......	......	......	13	......	7.7	15.4	15.4	21.0	30.7	7.7	......	......	......
Decorator	7	1	3	3	2	2	1	......	......	......	19	36.8	5.3	15.8	15.8	10.5	10.5	5.3	......	......	......
Total	110	69	52	37	25	22	32	14	8	4	373	29.4	18.5	13.9	9.9	6.7	5.9	8.5	3.8	2.2	1.1

SEX.

There are 7,819 more men than women employed in the plants surveyed; that is, 72 plus per cent of the workers are males, and 1,106 more men than women are exposed—that is, 79 plus per cent of workers exposed are males.

RACE AND NATIONALITY.

Only two colored employees were observed at work in the potteries, so that with very few exceptions the potteries are worked by the Caucasian race. Table IV gives the distribution by nationality for the various occupations.

TABLE IV.—*Nationality by occupation of pottery workers.*

Occupation.	Native born, native parents.		Native-born, foreign or mixed.		Foreign born.		Austrian.		Belgian.		Bohemian.		Bulgarian.		Canadian.		English.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Foreman, assistant	6	2			1												1	
Glaze mixer, sifter	59	4	18		51		3								1		9	
Dipper, enameler	173	1	42	1	62		2				1		1				20	
Dipper's helper, taker off	34	134	14	12	16	12	5	3		1					1			1
Ware carrier, gatherer	32	56	10	6	9	9	1	1		1							3	2
Ware cleaner, stamper, brusher	4	57	3	8		23		1		1		1						2
Glost-kiln placer	472		135		98	2	4								1		48	2
Kiln fireman	7		3		7	1											1	
Kiln drawer	6	4				1												
Oddman, utility	37	2	2		23		1										5	
Sagger washer, mender	39	4	2		27		5										3	
Decorator, tinter	4	11	1	8	5	1											1	1
Total	873	275	230	35	299	49	21	5	0	3	1	1	1	0	3	0	91	8

Occupation.	French.		German.		Greek.		Hungarian.		Irish.		Italian.		Polish.		Scotch.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Foreman, assistant																
Glaze mixer, sifter			4				11		3		8		8		1	
Dipper, enameler	1		4				19		5		5		2		2	
Dipper's helper, taker off			3							3	4		3	1		
Ware carrier, gatherer		1					1	1	1		2	1	1	2		
Ware cleaner, stamper, brusher								3		5				4		1
Glost-kiln placer	2		7				1		22		3		1		5	
Kiln fireman							3		2	1						
Kiln drawer										1						
Oddman, utility			1				2		1		11		2			
Sagger washer, mender	2		3		1				4		7		2			
Decorator, tinter			2				1						1			
Total	5	1	24	0	1	0	38	4	38	10	40	1	20	7	8	1

TABLE IV.—*Nationality by occupation of pottery workers*—Continued.

Occupation.	Welsh.		Roumanian.		Swiss.		Russian.		Slav.		Spanish.		Lithuanian.		Total.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Foreman, assistant															7	2
Glaze mixer, sifter					1		2								128	4
Dipper, enameler															277	2
Dipper's helper, taker off								1		1				1	64	158
Ware carrier, gatherer															51	71
Ware cleaner, stamper, brusher		1						3				1			7	88
Glost-kiln placer	2				2										705	2
Kiln fireman			1												17	1
Kiln drawer															6	5
Oddman, utility															62	2
Sagger washer, mender															68	4
Decorator, tinter															10	20
Total	2	1	1	0	3	0	2	4	0	1	0	1	0	1	1,402	359

It is seen from the table that by far the majority of pottery workers are native born, and that of the 21 foreign nationalities represented—17 of them by men—the English are most numerous. The nationalities of 1,402 males and 359 females were ascertained, and of the 1,402 males 873 are native born with native-born parents, 230 are native born with foreign and mixed parentage, while only 299 are foreign born. Thus, 1,103 are Americans, while the remaining 299 are divided into 21 nationalities. Of these the English are represented by the highest number, 91, followed by the Italians, with 40. Of the 359 women 310 are native born, 35 of these having foreign and mixed parents. Only 49 are foreign born. Therefore, we are justified in saying that the pottery industry in America is carried on mainly by native workers.

MARITAL STATE.

The marital conditions and fertility of the potters by sexes are shown in the following tables. Table V shows the marital state of male and female pottery employees by occupation:

TABLE V.—*Marital state by occupations.*

MEN.

Marital state.	Foreman.	Glaze mixer.	Dipper.	Dipper's helper.	Ware carrier.	Glost-kiln placer.	Ware cleaner.	Kiln fireman.	Kiln drawer.	Oddman.	Sagger washer.	Decorator.	Total.
Single	13	26	40	47	35	79	4	3	3	10	7	7	264
Married	30	73	217	18	20	545	3	9	2	57	58	4	1,036
Widowers	3	6	7	5		30				2	7		60
Divorced		2	3			8					1		14

WOMEN.

Marital state.	Foreman.	Glaze mixer.	Dipper.	Dipper's helper.	Ware carrier.	Glost-kiln placer.	Ware cleaner.	Kiln fireman.	Kiln drawer.	Oddman.	Sagger washer.	Decorator.	Total.
Single	3		1	76	30		40		1			11	162
Married	1		2	60	21		45		5			4	138
Widows	1			10	7		7					1	26
Divorced	1		1	3	1		2						8
Menstrual disorder	4			44	12		21		1			8	90

It will be observed that the majority of male workers are married. Of the 1,374 males of whom we have a record 1,110 are or have been married, 60 of them being widowers and 14 divorced; the remaining 264 are single. Of the 334 women concerning whom we have a record 162 are single, 172 are or have been married. Of the latter class 26 are widows and 8 divorced.

There is a higher per cent of single men among the dippers' helpers, ware carriers, cleaners, decorators, etc., while among the glaze mixers, dippers, kiln placers, and sagger washers the greater number are married.

TABLE VI.—*Fertility of pottery workers by occupation (men).*

Occupation.	Absolute.			Relative.		
	Marriages.	Children born.	Children living.	Marriages.	Children born.	Children living.
Foreman	33	98	85	100	298	257
Glaze mixer	81	255	190	100	315	234
Dipper	227	594	525	100	262	231
Dipper helper	23	48	37	100	209	161
Ware carrier	20	60	53	100	300	265
Glost-kiln placer	583	1,733	1,409	100	295	242
Ware cleaner	3	1	1	100	333	333
Kiln fireman	9	39	33	100	433	367
Kiln drawer	2	15	13	100	750	650
Oddman	59	207	167	100	351	283
Sagger washer	66	236	192	100	358	291
Decorator	4	12	10	100	300	250
Total	1,110	3,298	2,715	100	297	245

In the above table the first column includes all those who have been married, as shown in Table V. The second column shows the number of children born, and the third column the number of children living; for example, among the foremen there have been 33 marriages of which marriages 98 children have been born and 85 of these were living when this survey was made. In Table VI there is shown also the relative number of children that would be expected to be born and living on the basis of 100 marriages. This relation was computed upon the ratio furnished by the absolute figures shown in the first three columns of the table; for example, if there had been 100 marriages among the foremen we might expect 298 children to be born and 257 to be living, provided the same rate prevailed as in the 33 marriages of which we have a record. Among the 1,110 females there have been born 3,298 children, and of these 2,715 are still living. This is at the rate of almost three children born for each marriage and two and one-half still living, or 297 born per 100 marriages and 245 still living. Without analyzing these figures further for age variation, it appears that the male potters particularly have an average birth rate, and that a reasonably large proportion of their children are still living.

Table VII shows these same facts for the female workers, and includes additional information in regard to stillbirths, miscarriages, and abortions, as far as it was possible to obtain this latter information from the women themselves. It is of course understood that specific information concerning these matters is usually difficult to procure.

TABLE VII.—*Fertility of pottery workers by occupations (women).*

Occupation.	Absolute.						Relative.					
	Marriages.	Children born.	Children living.	Stillborn.	Miscarriages.	Abortions.	Marriages.	Children born.	Children living.	Stillborn.	Miscarriages.	Abortions.
Foreman	3	10	10	......	......	......	100	333	333	0	0	0
Dipper	3	12	8	......	......	......	100	400	267	0	0	0
Dipper's helper	73	157	106	5	2	12	100	215	145	7	3	17
Ware gatherer	29	88	72	4	......	4	100	304	248	14	0	14
Ware cleaner	54	141	109	4	1	......	100	261	202	7	2	0
Kiln drawer	5	11	10	1	......	......	100	220	200	20	0	0
Decorator	5	4	3	......	......	......	100	80	60	0	0	0
Total	172	423	318	14	3	16	100	246	185	8	2	9

It will be observed that this table is made up by a plan similar to that of Table VI. Among dippers' helpers there were 73 marriages, from which 157 children were born, with 106 still living. Among these same 73 women there occurred 5 stillbirths, 2 miscarriages, and 12 abortions. Reducing these figures to the rate of 100 marriages, 215 births might be expected, 145 still living, 7 stillbirths, 3 miscarriages, and 17 abortions, providing that the same rate prevailed among the 100 marriages as among the 73. Of the 172 marriages among the pottery women, 423 children had been born, and 318 were still living, at the time of this survey. This is at the rate of about two and one-half children per marriage of women workers, with approximately two children of each marriage still living; or 246 children born per 100 marriages, with 185 children living at the time of the survey. While this rate is not so high as that noted in Table VI for the male workers, it is to be remembered that these women are much younger than the male workers and have not been rearing families for so long a period as they. The rates, however, are about as high as might be expected for both the number of children born and the number of children living. The rate of stillbirths per 100 marriages is 8, of miscarriages 2, and of abortions 9. These rates do not seem exceptionally high, if all such cases have been reported to us. It does not appear that the high rates for these three marital conditions which are reported by Oliver in his study of the incidence of lead poisoning, as given in Diseases of Occupation,[1] prevail among the women workers in the lead department of the pottery industry.

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[1] Diseases of Occupation, Thomas Oliver, p. 199.

Table VIII gives by sexes and occupations the number of workers under 20 years of age, and the average age of those over 20; the average number of children born per marriage; and the average number and the per cent of children living.

Table VIII.—*Fertility, by occupations and sexes.*

MEN.

Occupation.	Number under 20.	Average over 20.	Average per family.		Per cent of children living.
			Children born.	Children living.	
Foreman	0	45.9	2.98	2.47	86
Glaze mixer	8	45.6	3.15	2.34	74
Dipper	8	38.5	2.62	2.31	88
Dipper's helper	35	33.8	2.09	1.61	77
Ware carrier	32	43.5	3.00	2.65	88
Ware cleaner	5	28.8	3.33	3.33	100
Glost-kiln placer	14	40.0	2.95	2.42	82
Kiln fireman	....	50.4	4.33	3.67	85
Kiln drawer	....	35.0	7.50	6.50	87
Oddman	2	45.3	3.51	2.83	81
Sagger washer	3	49.3	3.58	2.91	81
Decorator	1	34.6	3.00	2.50	83
Total	108	40.9	2.97	2.45	83

WOMEN.

Occupation.	Number under 20.	Average over 20.	Children born.	Children living.	Per cent of children living.
Forewoman	....	38.8	3.33	3.33	100
Dipper	1	35.0	4.00	2.67	67
Dipper's helper	47	30.0	2.15	1.45	68
Ware gatherer	25	31.7	3.04	2.48	82
Brusher	30	39.0	2.61	2.02	77
Kiln drawer	....	38.2	2.20	2.00	91
Decorator	7	31.2	.80	.60	75
Total	110	34.2	2.46	1.85	75.2

The number of children born per family ranges in this study from 1 to 8. The average number born and living per worker of either sex seems to be within the normal. Of the 3,298 children born whose fathers as pottery workers were exposed to lead 83 per cent were living at the time of this survey. Of the 423 children born whose mothers were working in the glaze department 75.2 per cent were living. It would seem, therefore, that we did not find anything of special significance in the marriage rates, in the birth rates, in the death rates of the children born, nor in the rates of stillbirth, miscarriage, and abortion among the potters examined in this survey. The lack of significant data relative to stillbirths, miscarriages, and abortions may probably be due to the difficulty met with in ascertaining all the facts.

OCCUPATION.

Length of employment in the pottery trades.—We gathered information concerning the length of time each individual examined had worked in the plant in which he was found at the time of the survey and concerning the length of the exposure of each to lead poisoning. Since no plant records were kept, the only possible source of information of this nature is the worker himself. Table IX gives by occupations and sexes the facts ascertained.

TABLE IX.—*Length of exposure and time in present plant of pottery workers, by sexes.*

Length of exposure.	Foreman.	Glaze mixer.	Dipper.	Dipper's helper.	Ware carrier.	Ware cleaner.	Glost-kiln placer.	Kiln fireman.	Kiln drawer.	Oddman.	Sagger washer.	Decorator.	Total.
MEN.													
0-2.9 months	......	7	13	16	7	......	13	......	......	10	9	3	78
3-5.9 months	1	5	8	10	10	1	12	......	......	3	4	......	54
6 months-0.9 year	......	13	9	12	10	3	11	......	......	5	3	1	67
1-1.9 years	......	11	4	11	8	......	17	......	2	4	11	1	69
2-4.9 years	6	18	19	9	13	3	92	4	1	15	15	......	195
5-9.9 years	3	31	52	6	3	2	112	2	1	16	7	5	240
10 years plus	29	27	160	7	3	......	450	6	......	16	24	2	724
Total	39	112	265	71	54	9	707	12	4	69	73	12	1,427
WOMEN.													
0-2.9 months	......	......	......	15	4	25	......	......	......	......	......	......	44
3-5.9 months	......	......	2	10	2	15	......	......	......	......	......	3	32
6 months-0.9 year	2	......	......	13	9	13	......	......	2	......	......	3	42
1-1.9 years	1	......	3	20	2	14	......	......	......	......	......	1	41
2-4.9 years	1	......	11	40	17	12	......	......	2	......	......	5	88
5-9.9 years	4	......	6	31	11	10	......	......	3	......	......	2	67
10 years plus	2	......	2	20	16	5	......	......	4	......	......	5	54
Total	10	......	24	149	61	94	......	......	11	......	......	19	368

Time in present plant.	Foreman.	Glaze mixer.	Dipper.	Dipper's helper.	Ware carrier.	Ware cleaner.	Glost-kiln placer.	Kiln fireman.	Kiln drawer.	Oddman.	Sagger washer.	Decorator.	Total.
MEN.													
0-2.9 months	......	5	13	7	9	1	27	......	......	4	2	3	91
3-5.9 months	1	1	6	12	5	......	17	1	......	1	2	......	46
6 months-0.9 year	1	8	6	11	6	1	23	......	......	1	1	1	59
1-1.9 years	......	10	7	6	4	1	23	......	......	4	7	1	63
2-4.9 years	3	11	19	12	13	2	70	2	......	7	18	3	160
5-9.9 years	3	15	32	6	2	......	92	2	3	8	10	3	176
10 years plus	5	26	57	7	4	2	147	2	......	5	9	......	264
Total	13	76	140	61	43	7	399	7	3	30	49	11	839
WOMEN.													
0-2.9 months	......	......	......	8	3	6	......	......	1	......	......	2	20
3-5.9 months	......	......	......	13	6	3	......	......	1	......	......	2	25
6 months-0.9 year	......	......	......	11	6	6	......	......	2	......	......	1	26
1-1.9 years	......	......	......	28	9	3	......	......	1	......	......	......	41
2-4.9 years	......	......	......	19	9	4	......	......	1	......	......	3	36
5-9.9 years	......	......	......	4	1	8	......	......	2	......	......	......	15
10 years plus	......	......	......	4	3	3	......	......	2	......	......	......	12
Total	......	......	......	87	37	33	......	......	10	......	......	8	175

Table IX shows that one-fifth of the men had been employed in the present plant for less than one year, a little over one-fourth had been employed more than one yeariand less than five years. The table also shows that about 14 per cent had been employed in the glaze department for less than one year, 18½ per cent more than one year but less than five years, and 67.5 per cent for five years and more. Slightly more than one-half of the men had been exposed to lead hazards for 10 years and more. These figures would indicate that the male potter remains in the same plant for a considerable period of years, and that he remains in the galze department at one occupation, or at various occupations, for a still longer time. Among the glost-kiln placers about 65 per cent of the men had been employed in the glaze department for 10 years and over. Among the dippers 70 per cent of the men had been working in lead for more than 10 years.

About 40 per cent of the men had been employed in the potteries in which they were found at the time of examination for less than one year, 44 per cent for more than one year and less than five years, and the remaining 16 per cent for five years and over.

But the mistake must not be made of interpreting these figures to indicate a large turnover, because it is a known fact that the turnover rate is highest during the first three months of employment. The data covering the rate of turnover in the potteries surveyed are not available. Approximately one-third of the workers had been exposed to the lead hazard for one year or less, another one-third more than one year or less than five years, and another one-third for five years and more.

Concerning the women it appears, as might be expected, that the occupation is not very stable and that they do not remain long in any one plant.

Previous occupations.—In order to justify the allegation that a certain industry exposes workers to a hazard, it is necessary, if the number of workers suffering from the effects of the hazard attributed to that industry is based upon physical examinations, to eliminate from the cases enumerated those of workers who may have developed their present physical findings in previous occupations.

The following tables give not only the number of workers who may have developed symptoms of plumbism before entering the potteries, but also the main sources of supply from which the workers are obtained.

TABLE X.—*Previous occupation of male pottery workers.*

Present occupation.	Previous occupation.																
	Firemen, assistant manager.	Glaze mixer, sifter.	Dipper, enameler.	Dipper's helper.	Ware carrier.	Ware cleaner, brusher, stamper.	Kiln placer.	Kiln fireman.	Kiln drawer.	Oddman, utility.	Sagger washer.	Decorator.	Other pottery.	Army.	Athlete.	Baker.	Barber.
Foreman, assistant manager	3	3	2	1	1	....	7	....	....	1	....	....	3	2	....	....	....
Glaze mixer, sifter	1	....	1	1	1	2	5	....	3	10	1	2	12	3	....	1	....
Dipper, enameler	1	1	3	19	16	9	20	....	1	7	4	3	22	6	1	1	....
Dipper's helper, taker off	....	....	1	2	1	....	1	....	....	....	1	....	11	2	....	....	....
Ware carrier, ware gatherer	....	1	2	....	....	7	3	....	4	3	....	1	2	....	....	....	....
Ware cleaner, brusher, stamper	....	....	....	....	....	....	1	....	....	....	....	....	1	1	....	....	....
Glost-kiln placer	4	12	10	1	21	14	34	2	65	20	6	5	95	9	1	2	2
Glost-kiln fireman	....	....	1	....	....	....	3	....	1	2	....	....	....	....	....	....	....
Glost-kiln drawer	....	....	....	....	....	....	....	....	....	1	....	....	1	....	....	....	....
Oddman, utility	1	....	1	1	4	....	1	....	1	2	3	....	4	1	....	....	....
Sagger washer	1	1	....	1	1	....	4	....	11	....	....	....	8	1	....	....	....
Decorator, tinter	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....
Total	11	18	21	26	45	42	79	2	86	46	15	12	159	25	2	4	2

Present occupation.	Previous occupation.															
	Bartender.	Blacksmith.	Bricklayer.	Carpenter.	Clerk.	Cigarmaker.	Electrician.	Engineer fireman.	Factory.	Farmer.	Iron and steel.	Laborer.	Livery.	Lumberman.	Machinist.	Mechanic.
Foreman, assistant manager	....	....	....	....	2	....	....	....	....	....	2	3	....	....	....	....
Glaze mixer, sifter	....	....	....	1	2	....	2	1	4	4	3	10	....	....	1	....
Dipper, enameler	....	....	3	2	2	1	1	....	10	10	2	19	....	....	3	....
Dipper's helper, taker off	....	....	1	....	....	....	....	....	....	....	2	5	....	....	....	....
Ware carrier, ware gatherer	....	....	1	....	1	....	....	....	3	3	....	1	1	....	....	....
Ware cleaner, brusher, stamper	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1
Glost-kiln placer	1	2	1	4	3	1	....	2	44	43	14	38	1	2	4	2
Glost-kiln fireman	....	....	....	....	....	....	....	....	1	....	2	....	....	....	....	....
Glost-kiln drawer	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....
Oddman, utility	1	....	1	1	....	....	....	....	2	8	3	10	....	....	1	....
Sagger washer	....	....	1	1	1	....	....	....	....	3	3	6	....	....	....	....
Decorator, tinter	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....
Total	2	2	8	9	11	2	3	3	64	74	31	93	2	2	9	3

Present occupation.	Previous occupation.																
	Merchant.	Messenger.	Molder.	Painter, paper hanger.	Packer.	Plumber.	Printer.	Railroad.	Student.	Stonemason.	Tailor.	Teamster.	No other occupation.	Miner.	Other occupation.	Total.
Foreman, assistant manager	2	....	....	....	....	....	....	1	....	....	....	1	....	1	....	35
Glaze mixer, sifter	1	....	1	....	1	1	1	2	....	1	1	4	21	4	2	111
Dipper, enameler	5	1	1	3	1	....	....	5	8	1	....	3	50	9	1	265
Dipper's helper, taker off	1	....	....	....	....	....	1	7	15	....	....	1	....	2	9	63
Ware carrier, ware gatherer	1	....	....	1	....	....	....	1	2	....	....	2	17	1	....	58
Ware cleaner, brusher, stamper	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	7
Glost-kiln placer	10	....	7	....	2	2	2	11	7	....	1	10	109	27	5	658
Glost-kiln fireman	1	....	....	....	....	....	....	....	....	....	....	....	1	....	....	12
Glost-kiln drawer	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	4
Oddman, utility	....	....	1	....	....	....	....	2	....	....	....	2	....	9	2	62
Sagger, washer	....	....	1	....	....	....	....	3	....	....	....	3	....	7	2	60
Decorator, tinter	....	....	....	2	....	....	....	....	....	....	....	1	....	....	2	8
Total	21	1	11	6	4	3	4	32	33	2	2	28	200	60	23	1,433

TABLE XI.—*Previous occupation of female pottery workers.*

Present occupation.	Previous occupations.																						
	Forewoman.	Glaze mixer.	Dipper, enameler.	Dipper's helper.	Ware carrier.	Ware cleaner.	Kiln drawer.	Kiln placer.	Decorator.	Other pottery.	Clerk.	Cigar maker.	Factory.	Housekeeper.	Laundry worker.	Saleswoman.	Seamstress.	Student.	Teacher.	Textile worker.	Waitress.	No other occupation.	Total.
Forewoman						1																2	3
Dipper						1			2					1							1	2	7
Dipper's helper			5	3	10	41	5	2	12	8	4		9	14	2			2			1	30	148
Ware carrier, gatherer			3	4	1	19	3		3	12	1			3							1	9	59
Ware cleaner, brusher, stamper	1	1	2	5	6	12	4		5	8	2	5	6	13		1	2	2		3	1	10	89
Kiln drawer			1			1		1	1	1	1			2							1	3	12
Decorator										1	2		1	1			1	3	1		2	1	13
Total	1	1	11	12	17	75	12	3	23	30	10	5	16	34	2	1	3	7	1	3	7	57	331

It is seen that among the men 5 were previously occupied as painters, 3 as plumbers, and 4 as printers, making a total of 12 who may have been exposed to lead before working in the potteries; but the number is so small that it is practically negligible. It is likewise seen that the largest number of men were previously occupied as laborers, factory hands, and farmers, although many had no former occupation. The women, as noted in Table XI, are generally recruited either from the nonemployed list or from housekeepers. A large number of men and women had held previous positions in the pottery, and some of these had not been exposed to lead in those positions. Among the men 167 had worked in occupations where lead was absent, and among the women 31 had been so employed.

Tables X and XII give the last previous occupation held by the workers according to present occupations.

TABLE XII.—*Next previous occupation of male pottery workers.*

Present occupation.	Next previous occupation.																	
	Foreman, assistant manager.	Glaze mixer, sifter.	Dipper, enameler.	Dipper's helper.	Ware carrier.	Ware cleaner, brusher, stamper.	Kiln placer.	Kiln fireman.	Kiln drawer.	Oddman, utility.	Sagger washer.	Decorator.	Other pottery.	Army.	Bartender.	Bricklayer.	Carpenter.	Car shops.
Foreman, assistant manager		1	1		1	1							2					
Glaze mixer, sifter			1				1		5	2	1	1	3	1			1	1
Dipper, enameler		1	3	3	5	2			1	1		1	9	5	1			
Dipper's helper				1	1				1			1	1					
Ware carrier, gatherer	1				2	1	1			2			1	1				
Ware cleaner, brusher, stamper						1			1									
Glost-kiln placer		2	6	2	5	2	9	1	5	7	4	4	29	11	1	2	4	5
Glost-kiln fireman			1								1			1		1		
Glost-kiln drawer											1							
Oddman, utility	3												1					
Sagger washer		1						1	3	3	1		3	1				
Decorator, tinter																		
Total	4	5	12	6	14	7	11	2	16	15	8	7	49	20	2	3	5	6

TABLE XII.—*Next previous occupation of male pottery workers*—Continued.

Present occupation.	Next previous occupation.																	
	Clerk.	Electrician.	Engineer-fireman.	Factory.	Farmer.	Iron and steel.	Laborer.	Machinist.	Merchant.	Messenger.	Miner.	Packer.	Plumber.	Railroad.	Salesman.	Student.	Teamster.	Other occupations.
Foreman, assistant manager					2	1							1					
Glaze mixer, sifter			2	4	4	3	7	1			1			2		1	1	
Dipper, enameler	1		2	4	8	1	7		1	1	2	1		2	2	3	1	3
Dipper's helper	2			4	3	5	1				3		1		1	2		
Ware carrier, gatherer				1	1	1	1								1	1	1	
Ware cleaner, brusher, stamper								1										
Glost-kiln placer	1	1	1	22	34	10	23	5	1	1	18	2	1	9	4	4	5	9
Glost-kiln fireman					1		1											
Glost-kiln drawer					1		2										1	
Oddman, utility	1		1	2	3		3							3				
Sagger washer		1	1	2	4	1	4							4				
Decorator, tiner						1											2	
Total	5	2	7	39	61	23	49	7	2	2	24	3	3	20	8	11	11	12

TABLE XIII.—*Next previous occupation of female pottery workers.*

Present occupation.	Next previous occupation.														
	Dipper.	Dipper's helper.	Ware carrier.	Ware cleaner.	Kiln drawer.	Kiln placer.	Decorator.	Other pottery.	Clerk.	Factory.	Housekeeper.	Laundry.	Saleswoman.	Seamstress.	Student.
Glaze mixer									1		1				
Dipper				4											
Dipper's helper	2		3	7	4	1	3	2	3	1	6	1			
Ware carrier		1		12			1	1			1				
Ware cleaner, brusher		1		5			1	2			7		1	1	1
Glost-kiln placer									1						
Decorator				1		1					1				
Total	2	2	3	29	4	2	5	5	5	1	16	1	1	1	1

There is very little to be learned from these tables, except that quite a number had held different positions in the potteries. It is also noted that only three had been plumbers. The conclusions to be drawn from these tables of previous occupations are that the physical findings of plumbism among the workers can not be attributed to former occupations.

Height and weight.—Table XIV shows a correlation of height and weight for 903 pottery men. Table XV shows the same data for 120 pottery women.

Table XIV.—*Height and weight of male pottery workers.*

[Average height=67.76 inches. Average weight=151 pounds.]

Weight (pounds).	Height (inches).																
	Under 60	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74+	Total.
200-+	....	....	....	....	....	1	....	3	2	2	4	1	2	3	1	....	19
190-199	....	....	....	....	1	....	....	....	3	3	4	2	2	2	3	1	21
180-189	....	....	....	....	....	1	....	4	4	8	4	8	7	3	2	1	42
175-179	....	1	....	....	....	....	4	3	3	5	3	4	1	1	....	....	25
170-174	....	....	....	....	....	1	5	2	3	5	5	7	6	5	....	....	39
165-169	....	....	....	1	....	2	1	6	9	4	8	12	14	4	2	3	66
160-164	1	....	....	1	....	2	2	7	10	9	17	13	11	10	1	....	84
155-159	....	....	....	....	....	6	7	13	10	16	11	16	17	2	....	....	98
150-154	....	1	....	2	....	4	8	13	9	25	12	14	6	6	....	....	100
145-149	....	4	1	1	4	5	7	16	16	17	17	17	8	2	....	....	115
140-144	....	2	....	1	2	7	7	14	11	16	15	1	1	5	....	....	82
135-139	....	....	....	2	3	14	9	10	18	16	9	2	....	1	....	....	84
130-134	....	2	....	1	2	5	5	5	6	5	4	2	2	....	....	....	39
120-129	....	5	....	2	1	12	5	9	3	2	2	3	....	....	....	....	44
110-119	1	1	1	2	2	5	1	3	....	....	....	....	....	....	....	....	16
Under 110	12	5	3	3	3	3	....	....	....	....	....	....	....	....	....	....	29
Total	14	21	5	16	18	68	61	108	107	133	115	102	77	44	9	5	903

Table XV.—*Height and weight of female pottery workers.*

[Average height=62.35 inches. Average weight=126.1 pounds.]

Weight (pounds).	Height (inches).																
	Under 60	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74+	Total.
170+	....	....	....	....	....	....	....	1	1	1	....	....	....	....	....	....	3
160-169	....	....	....	....	....	1	1	2	1	1	1	1	....	....	....	....	8
155-159	....	....	....	1	....	....	2	....	1	....	....	....	....	....	....	....	4
150-154	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
145-149	....	1	....	....	....	....	2	1	1	....	....	....	....	....	....	....	5
140-144	....	....	....	1	....	1	2	2	....	....	....	....	....	....	....	....	6
135-139	....	1	....	5	1	2	2	1	....	1	2	1	1	....	....	....	17
130-134	....	....	....	2	1	3	....	1	1	....	....	....	....	....	....	....	8
125-129	....	2	1	....	4	4	....	2	3	1	....	....	....	....	....	....	17
120-124	....	2	....	1	....	1	1	1	....	....	....	....	....	....	....	....	6
115-119	....	1	1	....	4	6	2	....	....	....	....	....	....	....	....	....	14
110-114	3	3	3	3	2	3	....	....	....	....	....	....	....	....	....	....	17
105-109	1	1	....	2	1	1	....	....	....	....	....	....	....	....	....	....	6
100-104	....	....	1	2	1	....	....	....	....	....	....	....	....	....	....	....	4
90-99	1	3	1	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Under 90	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Total	5	14	7	17	11	22	12	11	8	4	3	2	1	0	0	0	120

It is to be noted that the average height of the men is 67.5 inches and the average weight 151 pounds. The average height of the women is 62.35 inches and the average weight 126.1 pounds. In order that we may give a better picture of the group, the figures in Table XIV are analyzed a little more closely. Chart 1 shows the distribution of weights for the 903 male potters in a frequency curve upon which is superimposed for comparison a probability curve. Barring a few irregularities in the actual frequency curve, the weights do not seem to be abnormally distributed. By use of a frequency curve, upon which is superimposed for comparison a probability curve for this same number of workers, figure 2 shows the frequency distribution for the heights of these 903 pottery workers. A Pearson coefficient of correlation computed between these two parts of measures for the 903 individuals is 0.547, which is considered a reasonably good correlation, although it indicates considerable irregularity in these two measurements. That is, there are quite a number of individuals of overweight and quite a number of underweight, for their heights. Table XVI shows an attempt to find the deviation of these various height groups from what is considered a normal weight for each group. The standards taken are those of Butler, and vary about 5 pounds for each inch in height. An individual 67 inches in height is expected to weigh 150 pounds; one 68 inches in height, 155 pounds; one 66 inches in height, 145 pounds, etc.

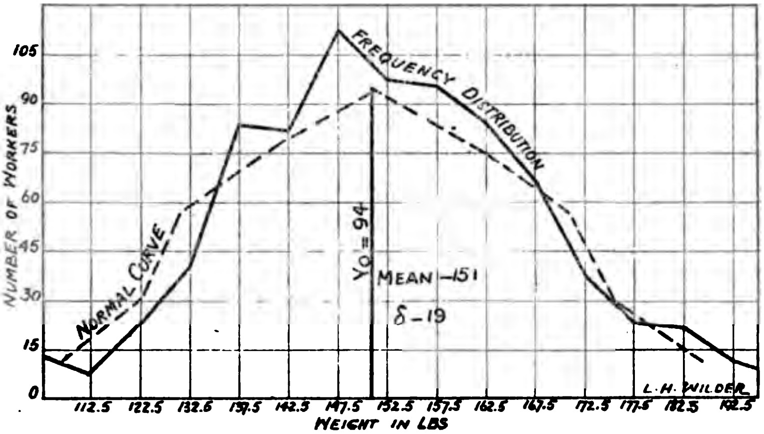

CHART 1.—Distribution of weight of 903 male pottery workers.

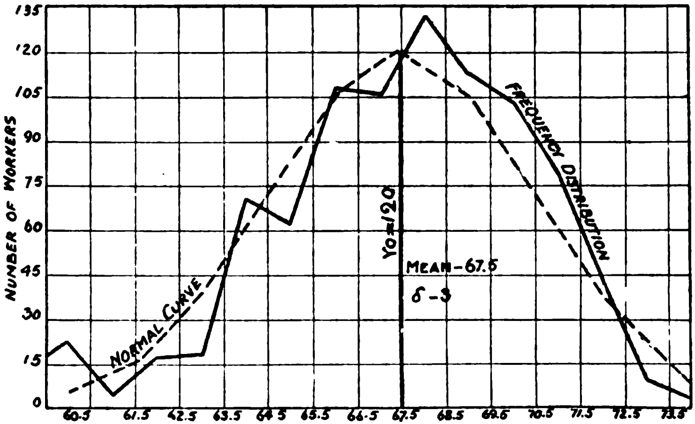

CHART 2.—Frequency of heights of male pottery workers.

TABLE XVI.—*Frequency of overweight and underweight among 903 pottery men.*

Height (inches).	Pounds underweight (average).					Pounds overweight (average).					
	25 plus.	15–24.9	10–14.9	5–9.9	0–4.9	4.9	5–9.9	10–14.9	15–24.5	15–34.9	35
Under 60...	0	0	4	4	4	1	0	0	0	0	1
60..........	0	0	2	2	1	1	2	2	2	6	2
61..........	0	1	1	1	1	0	0	0	0	1	0
62..........	0	3	1	1	1	1	1	2	2	2	2
63..........	0	5	1	1	1	2	3	2	4	0	1
64..........	0	8	5	7	5	14	7	5	10	4	3
65..........	0	3	3	5	8	7	7	8	9	6	4
66..........	0	12	5	10	14	16	13	13	13	5	7
67..........	....	9	18	11	16	9	10	10	12	7	5
68..........	2	21	16	17	25	16	9	4	10	8	5
69..........	6	24	17	12	11	17	8	5	5	4	6
70..........	7	18	14	16	13	12	7	4	8	2	1
71..........	3	14	17	11	14	6	1	4	4	3	0
72..........	8	8	10	4	5	1	2	1	2	3	0
73..........	0	1	2	0	0	1	1	2	1	1	0
74..........	0	3	0	0	0	1	1	0	0	0	0
Total.....	26	130	116	102	119	105	72	62	82	52	37
	156		337			239			171		

FAMILIARITY WITH TRADE HAZARDS.

Pottery workers, as a whole, are familiar with the lead hazard to which they are exposed. Their knowledge, however, is frequently very vague and is acquired through conversation with associates. Some, indeed, question the existence of such a hazard; and judging from the results of this survey many apparently do not appreciate the dangers thereof. The plants have taken no concerted action to teach the hazards in a logical way. One plant teaches them to some workers, four use placards, one gives instructions once a month and another every three months.

POTTERY BUILDINGS.

In general, the buildings in use for the manufacture of pottery are typical of an old industry, in which processes have remained so uniform as seemingly to demand no radical change of housing for a long series of years. The buildings are mostly makeshift structures, ill-adapted to the processes, although a few were found of modern type, arranged for the most efficient handling of the ware, from raw materials to finished product.

In the older buildings little attention was given to the convenience, comfort, or health of the worker. Glaze mixing was usually confined to an odd corner or to a room unusable for other purposes. Dipping rooms and kiln rooms, which, with the mixing rooms, primarily interest us, were apparently constructed with the idea of capacity mainly, without thought of illumination, ventilation, or any other sanitary consideration. Our investigators noted both dipping and mixing rooms where but one small window placed high in the wall was apparently expected to give ample ventilation, and, with the aid of an open-flame gas jet, sufficient illumination for safe conduct of the work. Though these instances are few in number, they typify the age to which such housing belongs, and in reality stamp such plants as outlawed in the field of modern construction.

Often, however, remodeled plants or plants having recent additions, though still retaining sections that have low walls and ceilings and inadequate illumination and ventilation, show in their newer sections acknowledgment of a need of those very features which the older buildings lack. This same effort toward improvement was found in plants built during the last decade, although these efforts often failed because of lack of full appreciation of the problems offered by the processes involved. The improvements in structures of this period is evident, however, several of the more recent being entirely of modern type and containing the best sanitary equipment and conveniences.

The change from old pottery processes, such as hand dipping and intermittent kilns, to automatic dipping and continuous tunnel kilns, for certain lines of ware, is effecting a substantial change in structure and involves a closer consideration of the sanitary problems relating to the handling of glaze. At the time of this survey continuous dipping and the use of tunnel kilns were confined to a very few plants, but a number had seriously planned to establish the use of continuous kilns; and doubtless by this time some have carried their plans into effect. The newly adopted processes will necessitate new housing, and they are mentioned here not for the purpose of discussing this change of process but as indicating a new epoch in the construction of pottery buildings. While the full significance of machine operation and continuous processes has perhaps not fully penetrated the entire industry, yet practical men of the industry have voiced the opinion that, when fully demonstrated, these new methods will result in a demand for the disuse of old buildings, to the advantage of both employee and employer.

PLANT PROCESSES AND MATERIALS USED.

LIMITATION OF SURVEY TO CERTAIN PROCESSES.

It is not our purpose in this study to give a description of those processes in pottery-making which do not involve the use of lead and its compounds. Each process in which a lead hazard is present is described in a general way, without attempt to include minor variations observed in a few plants. Wherever a process differs materially from the usual processes of other plants, full statements and descriptions are given.

The processes of mixing the clays and other basic materials for making the slip, or of reducing the clay to its proper plasticity for jiggering, pressing, and other methods of shaping the ware, are not ordinarily carried on in the same buildings, or at least in the same rooms, with the processes that involve the use of lead. The processes of burning and cleaning the ware, which is now called "bisque" or "biscuit" ware, are not ordinarily conducted so that the workers are involved in any lead hazard. The first introduction of the ware to the lead department occurs usually when the ware is carried from the ware room into the dipping room to be coated with a lead glaze. There are, though, some underglaze methods of decorating, which will be mentioned later. However, at times brushing of the biscuit ware may be carried on so that the workers come in contact with lead, or at least with glaze dust. It sometimes happens, also, that the bisque-kiln setting and the setting of glazed ware in the kilns are conducted in such a way that the same kiln, or the same kiln setters, are employed for both processes. In this survey when we found kiln placers working in both types of ware they are included among those exposed to a lead hazard. After stating one or two facts in regard to sagger making, our detailed description of processes takes up the mixing of the glaze, its application to the ware, the cleaning, burning, decorating of the ware, and all processes leading to the formation of the finished product.

SAGGER MAKING.

Sagger making of itself does not expose the worker to lead—a fact contrary to statements found in some books—but in the usual process of washing or painting the saggers with a lead glaze the worker is exposed. The process of sagger washing will be taken up later.

GLAZE MIXING.

On account of the secrecy of the formulæ used in glaze mixing the constituents are usually added under the direction of a chemist or some one else who is trusted by the management. The actual work is performed by a laborer, who is often kept in ignorance of the identity and proportions of the ingredients. The process is usually dusty, and the mixer neglects, as a general rule, to wear a respirator. The materials for glazes are kept in bins or barrels and when needed are shoveled into barrels or galvanized buckets and wheeled or carried to the scales to be weighed. Little uniformity of method was noticed in the several plants. In some the ingredients are poured into a glaze pan which has previously been charged with the proper amount of water, while in others they are mixed dry. Some use what is known as a "raw glaze," in contradistinction to a "fritted glaze." The latter, again, may or may not contain lead. When lead is

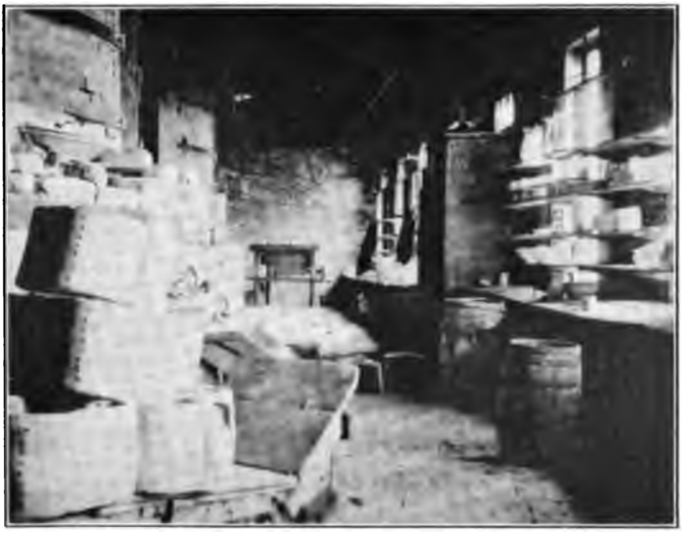

FIG. 1.—GLOST KILN ROOM. NOTE OLD CONSTRUCTION.

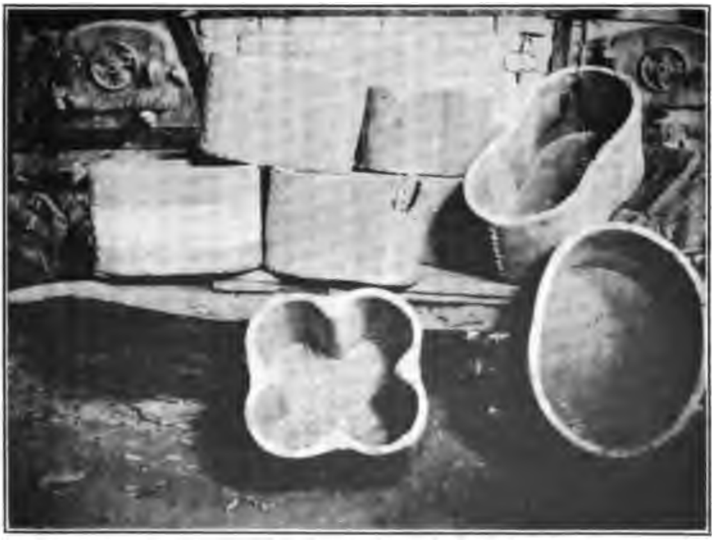

FIG. 2.—DIFFERENT TYPES OF SAGGERS.

present in the fritted form, it is usually called "fritted lead glaze," although this descriptive term is not always employed.

In the process of frit making the materials are emptied into a mixing box or hopper, whence by means of a chute they drop down into a mixer, where they are mixed either mechanically or by hand with a shovel, as concrete is mixed. Sometimes the batch is dampened by sprinkling it with water. The frit body usually consists of boracic acid, flint, whiting, spar, zinc oxide, and clay, and may or may not contain a lead salt. This mixture may amount to 40 per cent of the entire batch and often includes four-fifths of the lead.

The frit mixture is shoveled into glazed saggers or saggers lined with pulverized flint and is fused in one of the glost kilns. After removal from the kiln the fused glassy "frit" is taken from the saggers and broken up into small pieces or pulverized by means of a chaser or grinding mill. In some plants this pulverized frit is further sieved over a barrel. The managers of a few plants purchase the frit from other plants; some send the fused frit away to be pulverized.

The next step in the process of glaze mixing is to convey the frit, together with the weighed additional ingredients which enter into it, to a grinding mill or "wet-ball" mill, where the entire batch is mixed. The mixing requires frequently from two to six days. The additional ingredients consist usually of cobalt sulphate, white lead, and feldspar. Zinc may also be added. The mill is emptied either by means of buckets or by running its contents by gravity over a vibrating fine silk or lawn screen, through which the frit is filtered to remove any lumps or course materials. In a few plants the charge is "lawned" by hand, a process which consists in sifting the entire charge through a 150-mesh copper cloth screen. The finished glaze, which has a varying consistency depending upon its use, is then transferred by means of buckets or is pumped to a storage tank. Some of the storage tanks are equipped with agitators. From this point the glaze is carried or pumped, as needed, to the glaze-dipping tubs in the dipping room.

GLAZE DIPPING.

The process of covering the ware with a coat of glaze is known as "dipping" and requires skill and dexterity on the part of the operator. The glaze must be so applied that an equal covering of every part of the ware is attained, of a thickness determined by the porosity and shape of the pieces. The ware varies in size and weight from that of a small floor tile to ordinary household goods and sanitary ware, according to the product manufactured in each particular plant.

There are three different processes in use for covering the ware with glaze. In one process the ware, which includes dinner sets and pieces easily handled, is dipped into the glaze mixture; another process consists in dusting or spraying the pieces; and a third in painting the glaze on the ware. The method used depends upon the size, weight, and shape of the ware.

The hand immersion method is used in the majority of plants surveyed. In this method the glaze is contained in tubs, wooden or porcelain, about 4 feet in diameter and 3 feet in depth, set with the top at waist height. In an attempt to keep the glaze mixture of an equal consistency the dipper stirs it at times with a wooden paddle or simply with his hand. The dipper faces the tub, takes the pieces of baked ware, known as "biscuit" or "bisque" ware, previously placed beside the tub by his helper, dips the ware into the glaze, and on taking it out gives each piece a peculiar whirling or rotary motion of two or three half-turns in order to distribute the glaze evenly. With the larger pieces, such as sanitary toilet ware, this whirling is done on a bouncing board which spans the tub. While the piece is held by the dipper on the bouncing board, either he or his helper usually sponges the glaze off the foot of the piece while it is still wet. The dipper or his helper places the piece on the drying rack. After the glaze has dried on a sufficient number of pieces, the dipper and his helper "fettle" the ware, using a wet sponge. "Fettling" is the process of removing excess glaze.

Because of the heavy body of the glaze used in some potteries on sanitary toilets, washbowls, etc., it has never been possible to clean satisfactorily the feet and pipe inlets of the toilets with a wet sponge; and consequently after the ware is dipped it is allowed to dry and is then placed on a rotating wheel of plaster of Paris, on which the greater portion of the superfluous glaze is taken off dry with a steel tool, similar to that used in lathe work in making semivitreous cups of a certain type.

In some plants the dipping is done mechanically. The bisque ware is placed in piles on a table, on which is operated an automatic feeding device. Each piece as it drops is run through a pair of rolls onto a traveling belt. A large wheel which rotates in the glaze solution feeds the glaze to one of the rolls through which the ware must pass. The roll which spreads the glaze on the ware is constructed of some kind of spongy material covered with fine copper gauze. The pressure on this roll can be adjusted so as to give a thin or thick coating of glaze, as desired. As the dipped ware goes through the rolls it runs on a traveling belt and is taken off at the other end by a helper, who places it on boards or in saggers.

The glazing or art tile is usually done with a small brush. The tile is grasped in one hand, the brush wielded with the other. When a sufficient coat of glaze has been applied, the glazer removes the sur-

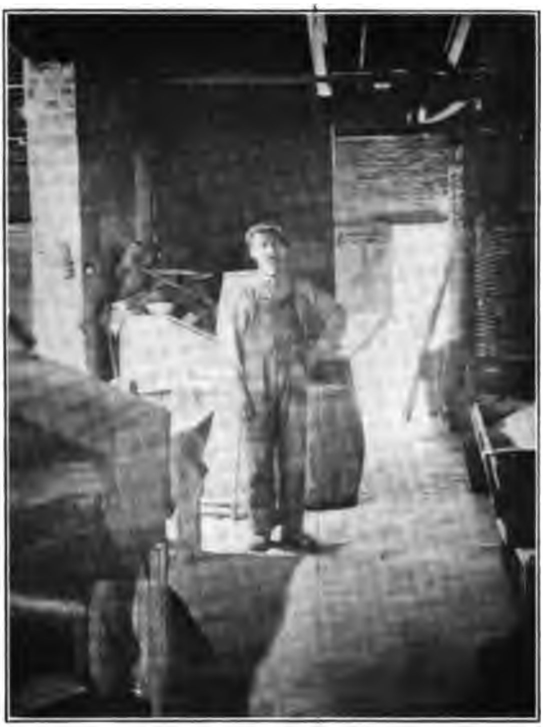

FIG. 3.—FRIT MIXING ROOM, SHOWING MACHINERY AND COMPOUND IN BIN AT RIGHT. NOTE NO COVERING.

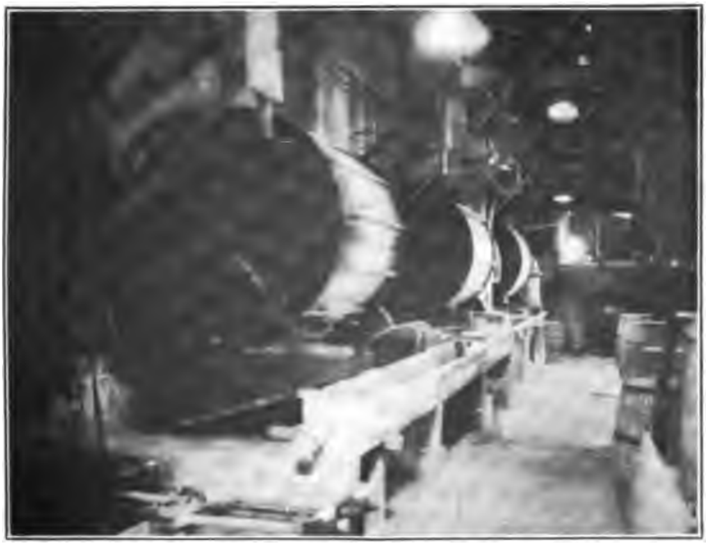

FIG. 4.—GLAZE MIXING ROOM, SHOWING MACHINERY FOR MIXING GLAZE.

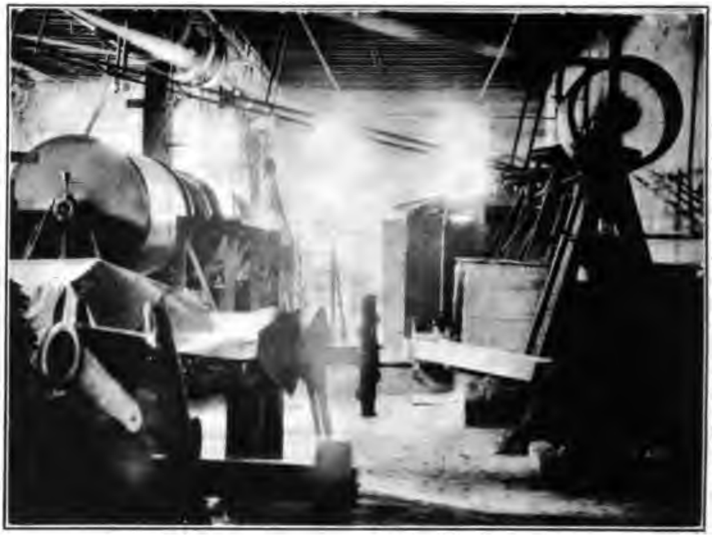

FIG. 5.—GLAZE MIXING ROOM, SHOWING MACHINERY FOR MIXING GLAZE.

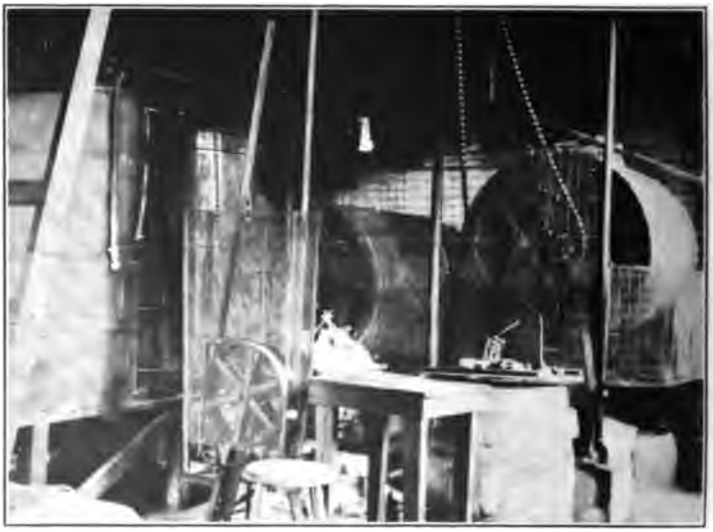

FIG. 6.—GLAZE MIXING ROOM, SHOWING MACHINERY FOR MIXING GLAZE AND SAFETY GUARDS ON MACHINERY.

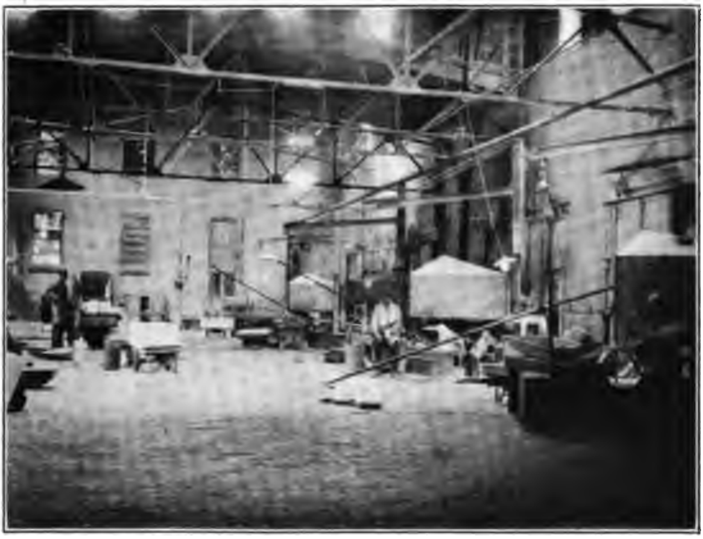

FIG. 7.—ENAMELING ROOM. NOTE GOOD NATURAL ILLUMINATION AND POSITION OF LOCAL LAMPS.

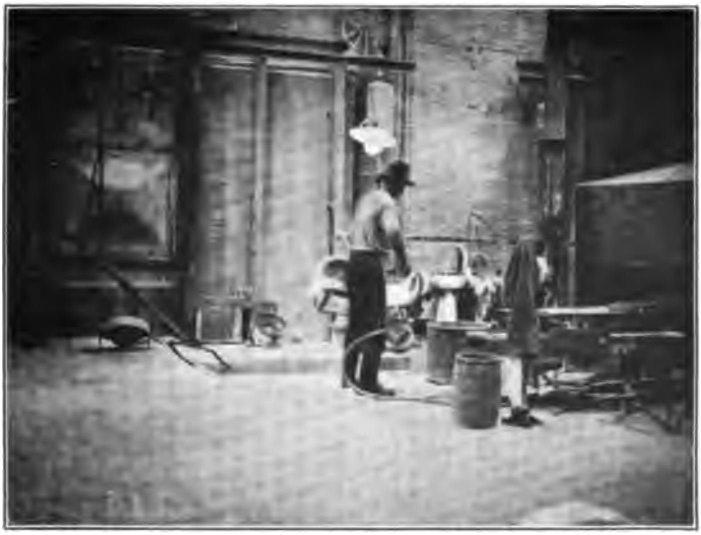

FIG. 8.—APPLYING THE ENAMEL, ENAMELING ROOM.

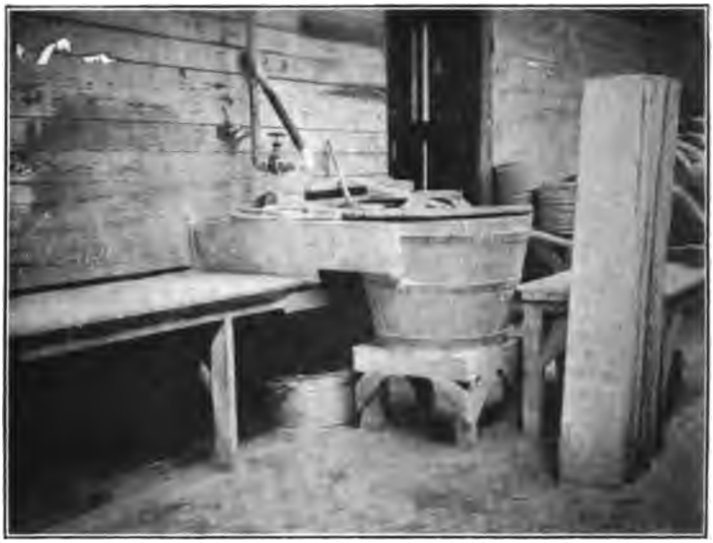

FIG. 9.—DIPPING TUB, WARE BOARD, ETC., ONE UNIT. NOTE PIPE FOR FILLING TUB INSTEAD OF BUCKET-CARRYING METHOD.

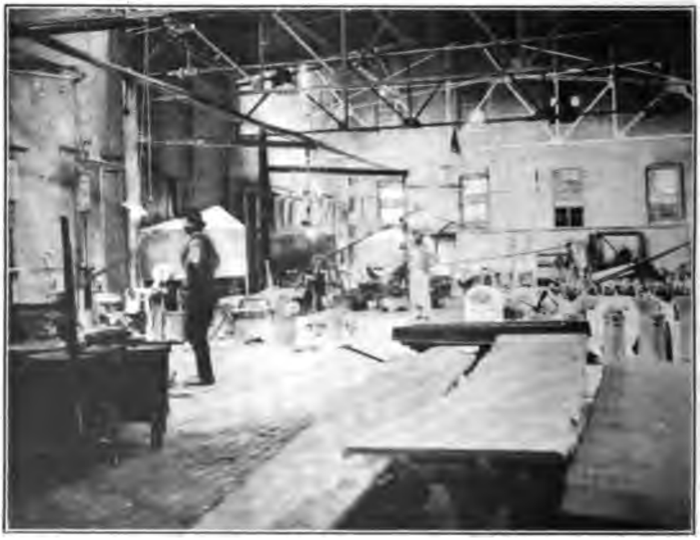

FIG. 10.—ENAMELING ROOM.

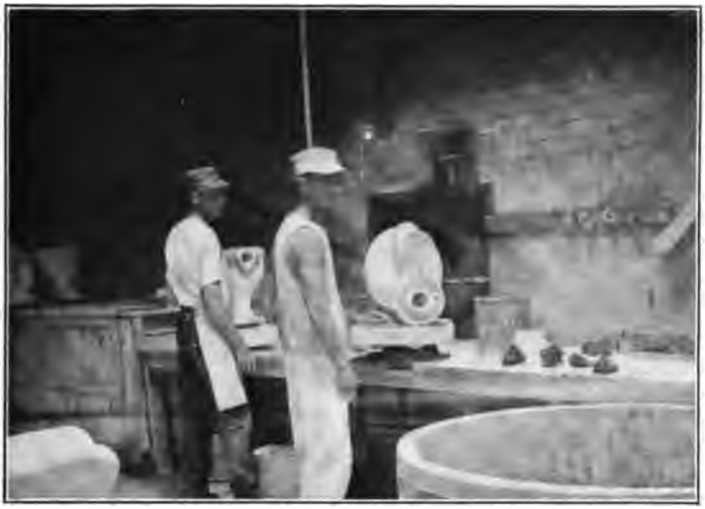

FIG. 11.—SHOWING METHOD OF REMOVING HEAVY GLAZE FROM WARE. SPONGES ARE OFTEN USED AND AFTER GLAZE BECOMES HARD A STEEL TOOL IS USED. NOTE PEDESTAL FOR REVOLVING THE WARE AND EXHAUST FAN IN WALL FOR REMOVING DUST.

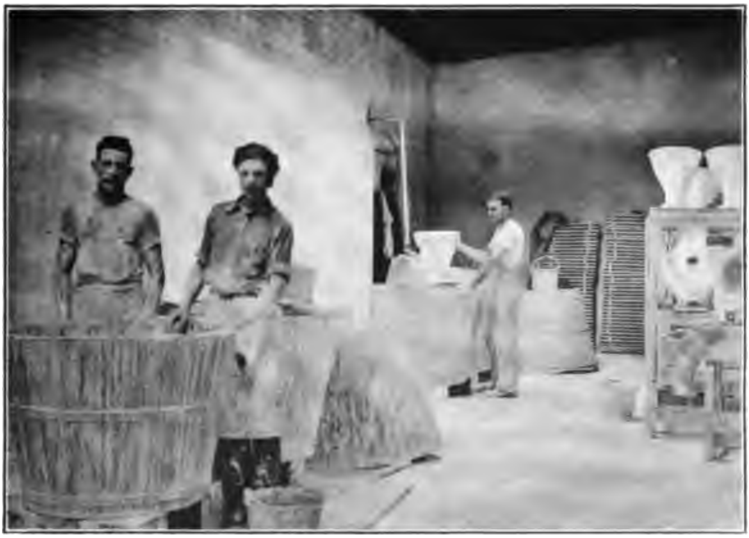

FIG. 12.—DIPPING DOOM SHOWING GLAZE ON FLOOR, WORKMEN, AND OUTSIDE OF TUBS.

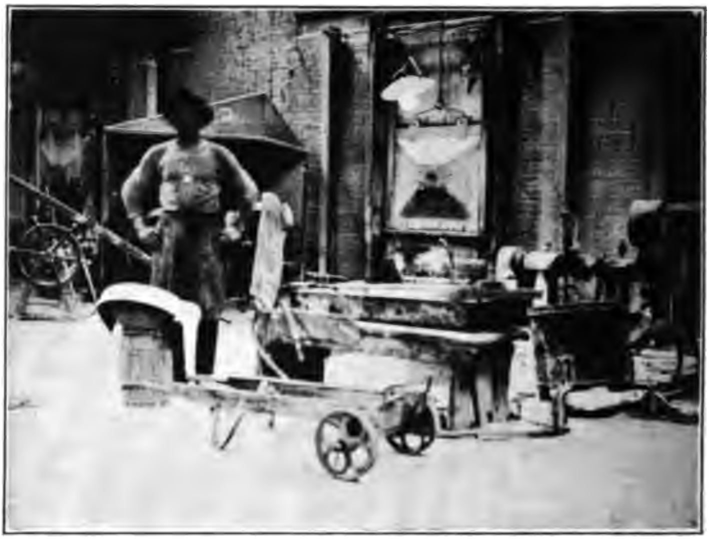

FIG. 13.—SHOWING WORK BENCH, OVEN, AND EQUIPMENT FOR APPLYING ENAMEL TO SANITARY WARE.

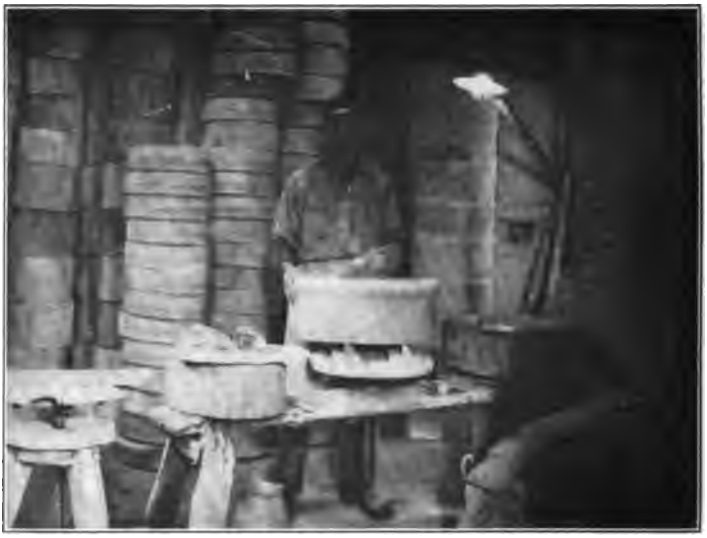

FIG. 14.—SAGGER WASHING. NOTE GLAZE ON HANDS OF WORKER AND DRY GLAZE ON EQUIPMENT.

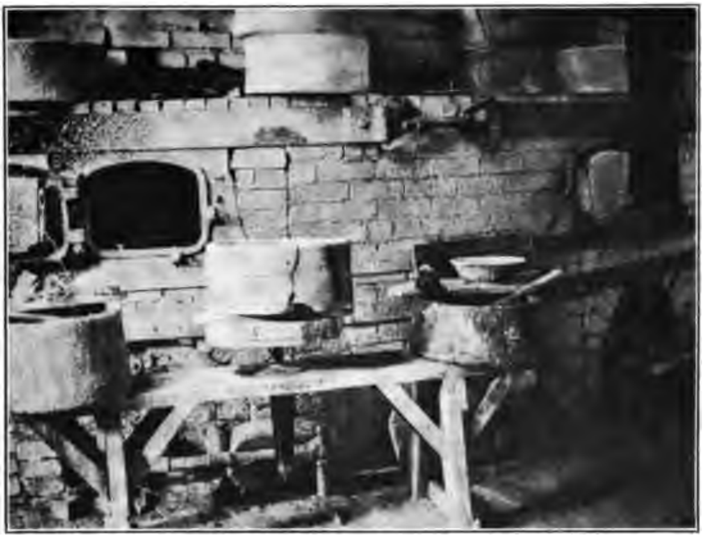

FIG. 15.—WORK BENCH FOR SAGGER WASHING. NOTE GLAZE ON SPONGES, PAN CONTAINERS, BENCH, FLOOR, AND WALL OF KILN. SAGGER TO BE WASHED ON REVOLVING PEDESTAL IN CENTER.

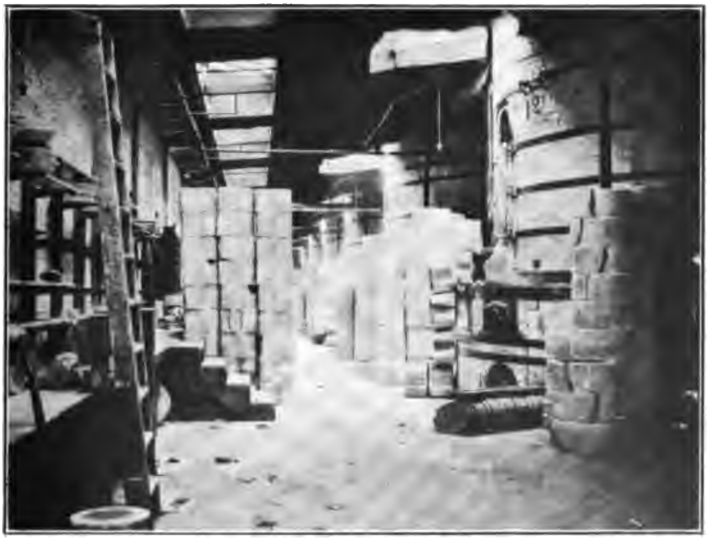

FIG. 16.—GENERAL VIEW OF A GLOST-KILN ROOM, SHOWING SAGGERS WARE WORK BENCHES, KILNS, AND ROOF ILLUMINATION.

plus from the tile edge by scraping it with his finger before placing the tile upon the flat board upon which it is carried away.

In one plant where art pottery is made the glaze is applied by means of compressed-air spraying. The ware is placed upon a revolving pedestal in an inclosed compartment. The glaze is sprayed upon it as the pedestal revolves, exposing all sides of the ware to the spray.

Another method of applying glaze consists in "dusting" the pieces with a dry powder of the glazing material. This is the usual method employed in enameling large pieces of cast-iron ware, such as bath tubs. To make the enameling adhere to the iron, such pieces are first covered with a base coat, applied by means of spraying machines, by which a fine spray is thrown upon the ware. After the base coat has dried, the ware is placed in one of the furnaces and heated to a bright red heat. While it is still glowing, the enameler reaches in with a pair of tongs suspended from a swinging crane, withdraws the ware from the furnace, and places it on the workbench. This workbench is operated by the foot and can be turned to any desired position. Holding in both hands a long-handled sieve, which is pneumatically shaken, the enameler sifts the powdered glaze carefully and evenly over the hot ware. He returns the piece to the furnace and heats it again until the glaze has been well fused; then it is taken out and a second coat is applied in the same manner as was the first, and the ware is again placed in the furnace. When the final coat is properly fused, the piece is withdrawn and placed under the "hood," where, shielded from rapid circulation of air, it may cool slowly and evenly.

SAGGER WASHING.

A glaze, which may be the same as that used in the dipping process or a cheaper grade of glaze—sometimes red lead, or the dregs of the dipping tubs—is applied by means of a paint brush to the inside bottom, sides, and tops of the saggers. This prevents the saggers from absorbing the glaze from the ware with which they come in contact. Again, the bottoms of the saggers are frequently washed with ground bone suspended in water. The object of this is to prevent the ware and the "setters" upon which the ware rests from sticking to the sagger. This washing is usually done by a laborer or kiln drawer, in a corner of the kiln room or wherever the saggers happen to be.

GLOST-KILN WORK.

The kiln placing—proficiency in which process requires considerable experience—is done by men most of whom have served an apprenticeship. The kiln placer carries the dipped ware from the drying shelves in the dipping room to the workbenches in the kiln room. Here the ware is placed in saggers, in such a way as not to touch each other nor the sides of the sagger and at the same time to utilize space to the best advantage. A proper selection of supports for the pieces, so that they stand on each other without touching, is important. This process is an art, and if loss is to be avoided each piece must be carefully placed.

The saggers are separated by clay "wads" to prevent then from sticking together, to keep them level, and also to seal them from the entrance of smoke. As the saggers are filled they are carried on the head, which is protected by a thick pad, to the kiln. They are placed in position, one above the other in a position corresponding to the amount of heat needed to finish the ware, until the kiln is filled to the top. As the pile rises, a ladder must be used by the kiln placer in order to reach the top of the pile. Where tunnel kilns are used, the ware is placed on trucks which run through the tunnel kiln. Saggers may or may not be used in the continuous kiln. The truck when loaded is only about 7 feet high; hence the arduous and somewhat dangerous work of climbing up stepladders is eliminated.

Firing the kilns demands considerable skill and requires accurate knowledge of each particular glaze used and familiarity with any alteration in its fusibility. The tunnel kiln is fired continuously. Trucks of ware are put in at the rate of one every hour and a half, and are carried through in from 48 to 54 hours. As a truck of ware is pushed in at one end, a truck of glazed ware comes out at the other. A small motor, geared to a worm wheel, operates a pushing arm, which keeps the cars of ware always moving at uniform speed.

Kiln drawing is the reverse of kiln placing, and consists in removing from the kilns the baked ware, which is taken off by laborers and carried to the storage or packing rooms. This process requires care—but no great degree of skill—for the saggers must be so carried that pieces do not fall against each other.

DECORATING.

Mechanical processes of decorating earthenware are frequently used, but hand painting will perhaps continue in use as long as the demand for skilful hand art prevails. The absolute correctness of decorations printed by mechanical processes becomes monotonous and militates against the general use of such decorations. The two methods of hand painting in vogue are underglaze and overglaze painting. The highly artistic work is done over the glaze. The underglaze work is much cheaper, but presents a rich, glossy appearance.

The art of painting bands of various widths around the periphery of the ware is called "lining." This work is done entirely by hand.

The width of the lining is determined by the size of the brush used and by the pressure applied. The ware is usually centered on a small horizontal wheel, which is revolved by hand.

Decalcomania is a process of decoration the use of which is becoming more frequent. The design is first printed on a specially prepared sheet of tissue paper and is then transferred to the ware. The original design is engraved on a copper plate and colored, the excess color being scraped off with a knife, so that the coloring matter remains only in the lines engraved on the plate. A specially prepared sheet of tissue paper is then spread evenly over the plate and the whole is put through a press, which transfers the color design to the paper. The designs are then cut out and stuck on the ware, the surface of which has been prepared with a coat of special varnish sizing. By means of rubbing the surface of the paper smooth with a stiff brush, the color is transferred from the paper to the ware. When a sufficient quantity of color has adhered, the paper is washed off with water, and the decoration remains on the ware.

This latter process has largely replaced hand decorating, which was formerly responsible for the lead poisoning in decorating.

LEAD IN GLAZE USED.

Tables.—In studying these tables it must be remembered that the amount of total lead present in any sample of glaze is not proportionate to the amount of soluble glaze in the sample, and vice versa. The lead becomes a hazard to the worker only when it is soluble. It will be noted that the average per cent of soluble lead is high in the glaze used for yellow, art, and general ware, namely, 24.93, 16.65, and 13.71, respectively. In the glaze in use we found samples containing as much as 45.70 per cent of soluble lead. Analysis of the lead content was made from samples taken from the tub while the process of dipping was going on, and it was not infrequent to find the percentage of lead higher or lower than the amount originally alleged to be used in mixing the glaze. In some plants the tubs are emptied periodically. In others, however, the glaze is added to the tubs from time to time. The difference between the laboratory analysis and the lead content originally put into the glaze may indicate a laxity on the part of the dipper in properly agitating the glaze. In this way the lead content may vary slightly from the original mixture.

PER CENT OF LEAD USED IN GLAZE.

We collected and analyzed 107 samples of glaze used in 87 plants. The following tables show, by States and wares, the per cent of lead in the glaze.

TABLE XVII.—*Per cent soluble lead in glaze.*

	New Jersey.		Ohio.					Pennsylvania.		West Virginia.		Total
	Sanitary.	General.	Sanitary.	General.	Yellow.	Art.	Tile.	Sanitary.	General.	Sanitary.	General.	
No lead	1	......	......	......	......	......	2	......	......	......	......	3
Under 5 per cent	......	1	......	......	......	......	1	......	......	......	1	3
5-9.9 per cent	4	1	......	2	1	1	1	......	1	1	......	12
10-14.9 per cent	11	8	1	28	1	1	......	1	4	1	9	65
15-19.9 per cent	2	3	......	4	1	1	......	1	......	1	......	13
20-24.9 per cent	3	......	......	......	......	......	......	......	......	......	......	3
25-29.9 per cent	......	2	......	......	......	1	......	......	......	......	......	3
30-39.9 per cent	......	1	......	......	1	......	......	......	......	......	......	2
40-49.9 per cent	......	1	......	......	1	......	1	......	......	......	......	3
Average	12.63	17.40	9.83	13.27	24.93	16.65	10.76	15.19	10.47	15.27	11.92	13.95

Average per cent for each ware as follows: Sanitary, 12.11; general, 13.71; yellow, 24.93; art, 16.65; tile, 10.76.

TABLE XVIII.—*Per cent of total lead in glaze.*

	New Jersey.		Ohio.					Pennsylvania.		West Virginia.		Total.
	Sanitary.	General.	Sanitary.	General.	Yellow.	Art.	Tile.	Sanitary.	General.	Sanitary.	General.	
5-9.9 per cent	......	2	......	......	......	1	......	......	......	......	......	3
10-14.9 per cent	1	3	......	19	......	1	1	......	5	1	8	39
15-19.9 per cent	15	7	1	9	3	......	1	2	......	1	2	41
20-24.9 per cent	5	1	......	5	......	1	1	......	......	1	......	14
25-29.9 per cent	......	2	......	1	......	......	......	......	......	......	......	3
30-39.9 per cent	......	1	......	......	1	1	1	......	......	......	......	4
40-49.9 per cent	......	1	......	......	1	......	1	......	......	......	......	3
Average	18.81	19.60	17.96	15.73	26.72	20.03	26.78	16.98	11.94	16.35	13.94	16.99

Average per cent for each ware as follows: Sanitary, 18.48; general, 16; yellow, 29.35; art, 20.03; tile, 26.76.

It will be observed from the table that the average amount of lead in these 107 samples taken from the tubs is 16.9 per cent and that 78 of the samples, or 73 per cent of them, contain between 10 and 20 per cent of soluble lead. While this table does not show the average amount according to the type of ware manufactured, yet it does show that the highest per cent of lead, which is 26.72 per cent, is used in glazing the yellow ware. In the tile ware the amount of lead is 26.7 per cent. In the art ware it is 20.03 per cent of the glaze, while in the sanitary ware it is 18.4 per cent of the dry glaze. A glance at these rates is sufficient evidence that American potters are not aware of the number of leadless glazes available. A discussion of leadless and fritted glazes will appear later.

PLANT EQUIPMENT AND PROCESSES.

A description of the plant equipment for processes as found by our investigators is here duplicated in part, so that a picture may be presented which will convey to the reader some impression of the antiquated style of equipment still in use in an industry which, though old, is nevertheless increasing in size, production, wealth, and recognition in the local markets.

TYPES OF TUBS.

In our description of the process of dipping we mentioned the ordinary type of tub used in the potteries. In some plants a still smaller tub is used, in which a more uniform agitation of glaze is possible. The tubs were made of either wood or porcelain, the former material predominating in the plants surveyed by our field men. These are located in a convenient place, usually near a window, and may be adjusted to the height of the dipper.

DRYING RACKS.

The racks used for the purpose of temporarily storing the dipped ware when the glaze is drying are usually located in or near the dipping room and in a place quite accessible to the glost-kiln room, because the ware must be carried from the dipping tubs to these racks, from the racks to benches where the ware is placed in saggers, and thence to the kilns. The racks are usually of wood, and are frequently arranged along the walls or sides of the room, although often they are placed in tiers or rows in the central part. They are usually made so that the ware boards can be stacked upon them, the racks and boards together presenting the appearance of shelves. Ample space is left between the boards for circulation of air and between the racks for the movement of cars or workers.

HOW GLAZE IS CONVEYED FROM MIXING ROOM TO TUBS.

In a few plants the glaze is conveyed from the mixing room to the tubs by means of pipes, but in the majority of plants such labor-saving and health-protecting means are not employed. The glaze is very often carried in buckets, and in a great many plants the glaze room is on the first floor, while the dipping is done on the second, so that it is necessary to carry the glaze up a flight or two of stairs, occasionally through one or two other rooms, to reach the dipping tub.

The conveying of glaze in this manner occasions many chances of spilling; it necessitates, also, frequent stirring of the ingredients of the mixing tub, the continual annoyance of the dipper and his helpers, and additional splashing of the dipping tub. Thus it needlessly exposes a large number of workers to glaze dust and by increasing the spilling, increases the dust hazard.

KILNS.

Almost without exception use is made of the ordinary intermittent kiln in the plants surveyed. The process of placing the saggers in both kinds of kilns has been explained under "Plant processes." The advantages of continuous kilns will be discussed later.

Intermittent kilns are large circular ovens varying in height, but their loading height is usually from 12 to 13 feet; above this level they taper to form a chimney point. Ordinarily there is a false roof with openings which assist in regulating the heat. The kilns are heated by fire boxes, fired by gas or coal, and distributed at regular intervals around the base of the kilns. The temperature is determined by the use of cones and disks, by the melting of which certain temperatures are indicated. The construction of the kiln is such that the high temperature within it does not cause an abnormally high temperature in the workroom. Practically all kilns are above the level of the floor, so that entrance to them is attained by means of a series of steps.

WORKBENCHES, WARE BOARDS, SAGGER BOXES, AND OVERHEAD CARRIERS.

In most plants the workbenches are of wood. They are usually placed along the wall in the vicinity of the kiln doors. They are of convenient height for the kiln placers, who place on them the saggers to be filled with the glazed ware. Very frequently the benches are not kept well cleaned, and a great deal of dust containing lead is likely to accumulate and to add to the hazards already noted in the glaze department. In general pottery-ware plants, racks, designed to hold temporarily the ware boards unloaded for sagger filling, are built above the workbenches. In lowering the boards to the racks a considerable amount of visible dust is created.

The ware boards are made of wood and are designed to be of sufficient size and strength to enable them to hold the ware while it is drying, or while it is being transferred from one room to another. The ware boards are cleaned by washing and scraping them, usually in a tank. The loosened glaze is allowed to settle at the bottom of the tank and is later recovered.

The saggers are of such size, shape, and weight as to suit the ware for which they are to be used when loaded. Saggers, according to their contents, vary in weight from 50 to 100 pounds. As we stated above, these saggers are placed upon the workbenches, to be washed and filled with the dipped ware; and they are then carried—usually upon the heads of the kiln placers—into the kilns, where they are set in place for firing. The individual saggers are not covered, but saggers of like size are placed in tiers, one above the other, in such manner that each sagger forms a perfect seal for the one beneath it. Only the top saggers are provided with independent covers.

LABOR-SAVING MACHINERY.

While carts, wheelbarrows, and other transportation facilities are provided for handling the rougher material, as in emptying saggers or transporting the glaze tubs, the majority of workers, including those engaged in the more skilled occupations, are not relieved from the arduous tasks of lifting and carrying the saggers and ware boards.

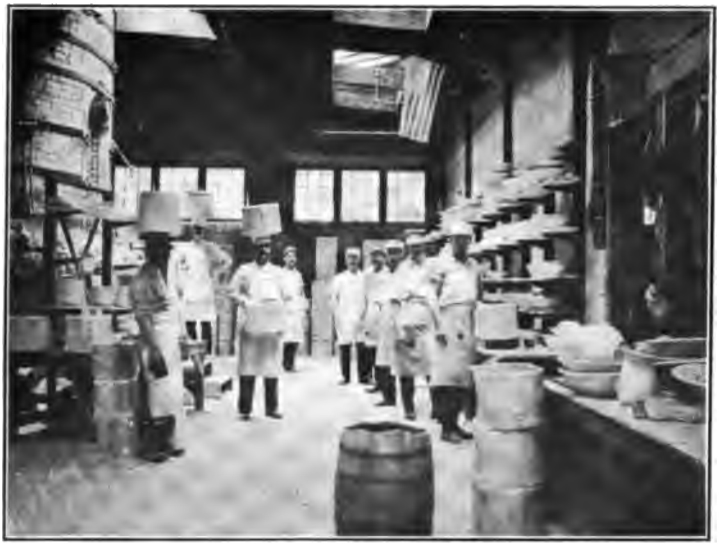

FIG. 17.—GLOST KILN PLACING. NOTE MEN WITH SAGGERS ON THEIR HEADS, STEPS LEADING INTO KILN, WORK-BENCHES, POTTERY WARE, WORK APRONS, AND ILLUMINATION OF ROOM. THIS ROOM IS WELL LIGHTED.

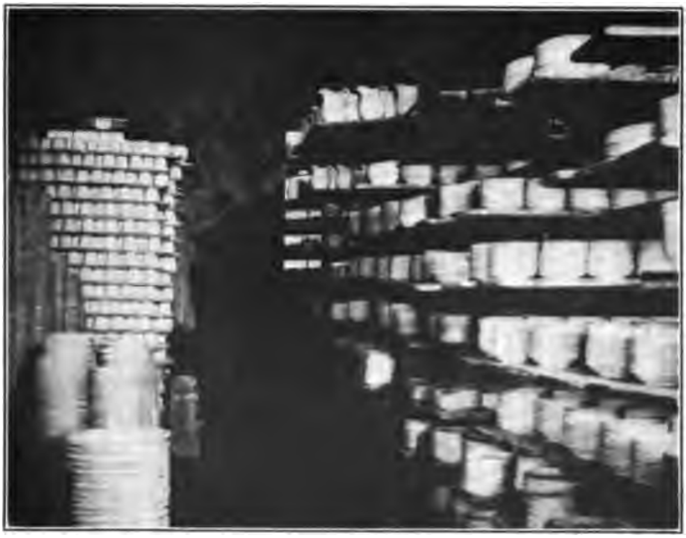

FIG. 18.—DRYING RACKS FOR DIPPED WARE.

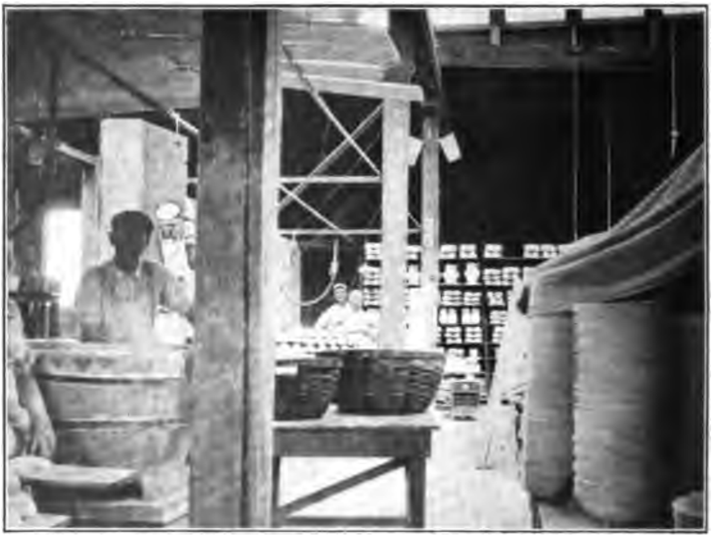

FIG. 19.—SHOWING DRYING RACKS, AND WARE AND DIPPING TUB IN A LARGE ROOM.

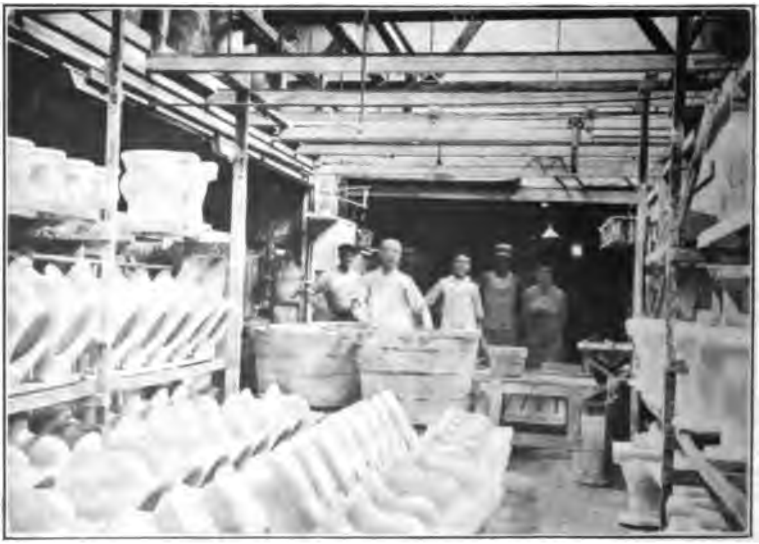

FIG. 20.—SHOWING SANITARY WARE ON DRYING RACKS AFTER DIPPING. DIPPING TUBS IN BACKGROUND.

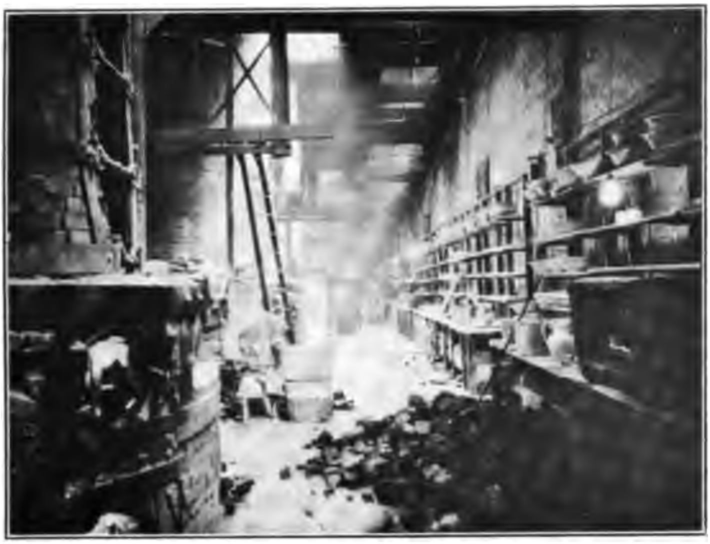

FIG. 21.—KILN ROOM SHOWING WORK BENCHES (ON RIGHT) WITH WARE BOARDS AND WARE ON SUPPORTS, KILNS ON LEFT, COAL ON FLOOR IN FOREGROUND, AND GENERAL UNTIDY CONDITION OF KILN ROOM.

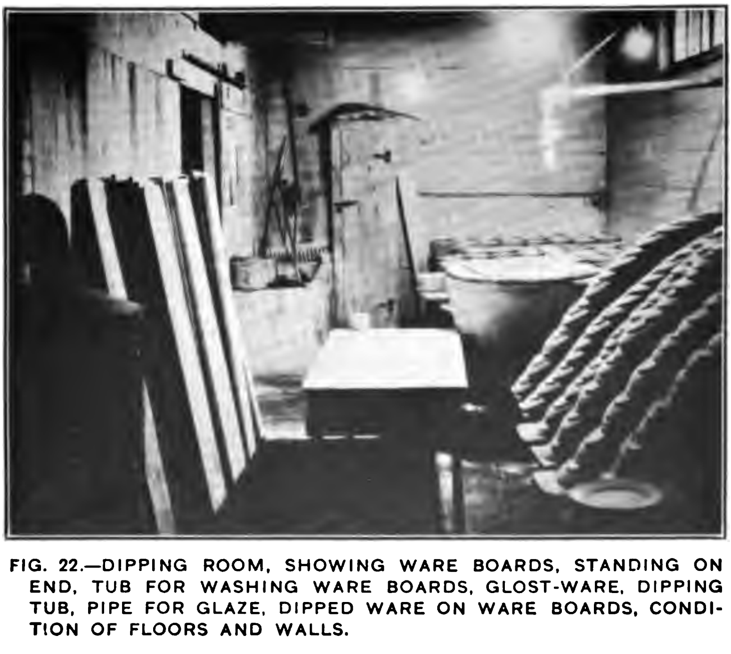

FIG. 22.—DIPPING ROOM, SHOWING WARE BOARDS, STANDING ON END, TUB FOR WASHING WARE BOARDS, GLOST-WARE, DIPPING TUB, PIPE FOR GLAZE, DIPPED WARE ON WARE BOARDS, CONDITION OF FLOORS AND WALLS.

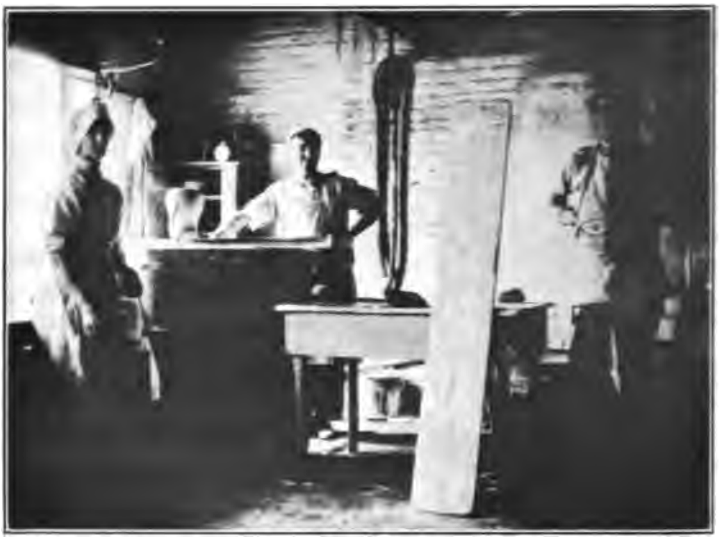

FIG. 23.—DIPPING ROOM. WARE BOARD IN CENTER SHOWS DRY GLAZE, ONE OF THE PRINCIPAL SOURCES OF DUST.

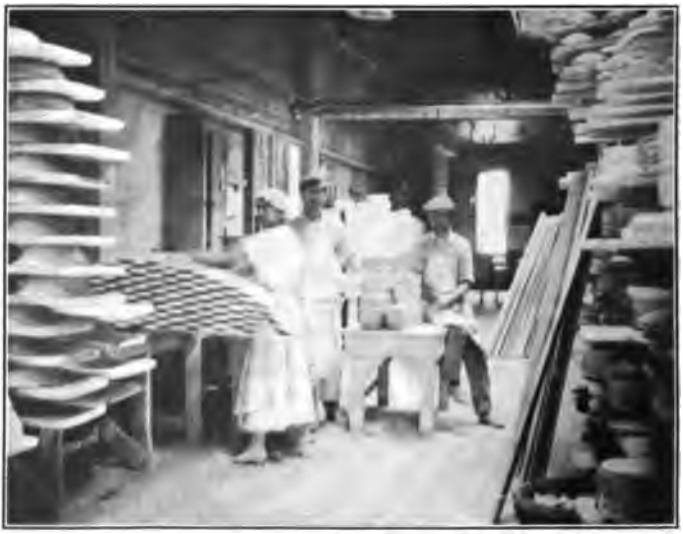

FIG. 24.—DIPPING ROOM, SHOWING MANNER OF DIPPING THE WARE AND USE OF THE WARE BOARDS. WARE BOARDS STANDING ON END ON RIGHT SIDE OF PICTURE.

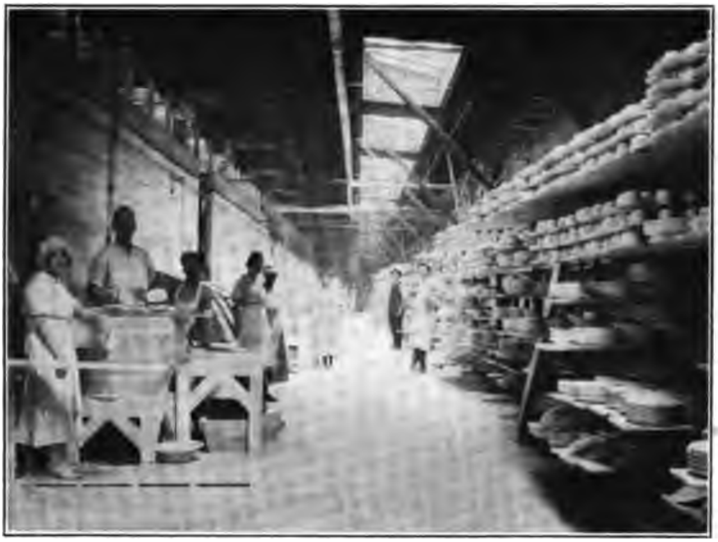

FIG. 25.—SHOWING NUMBER OF WARE BOARDS NEEDED IN A PLANT. ALL WARE PLACED ON WARE BOARDS AFTER DIPPING.

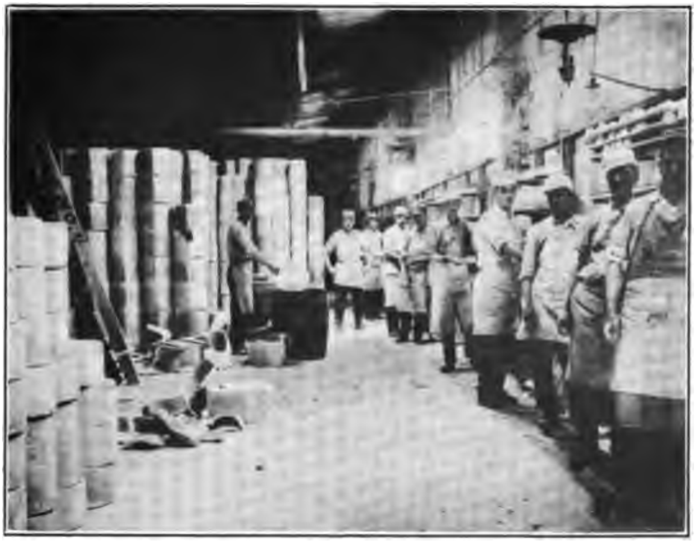

FIG. 26.—GLOST KILN PLACERS AT WORK BENCHES LOADING SAGGERS. EMPTY SAGGERS ON LEFT. NOTE BROKEN SAGGERS ON FLOOR.

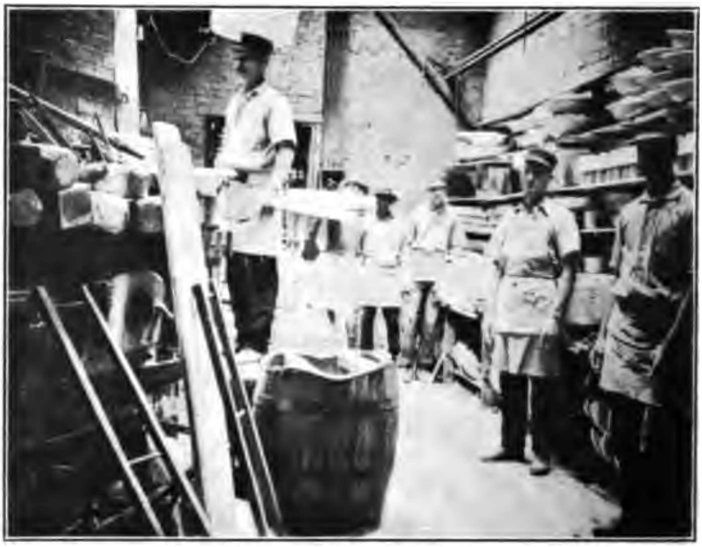

FIG. 27.—KILN PLACING. NOTE KILN PLACER WITH LOADED SAGGER ON HEAD CLIMBING STEPS OF KILN, WARE BOARDS LEANING AGAINST KILN, WARE CARRIER OR KILN PLACER IN BACKGROUND WITH WARE BOARD COVERED WITH DIPPED WARE, KILN PLACERS OR SAGGER LOADERS AT WORK BENCHES, WARE BOARDS WITH WARE ON BRACKETS ABOVE WORK BENCHES, APRONS ON WORKMEN, CLOTHING OF WORKMEN AND CONDITION OF FLOOR.

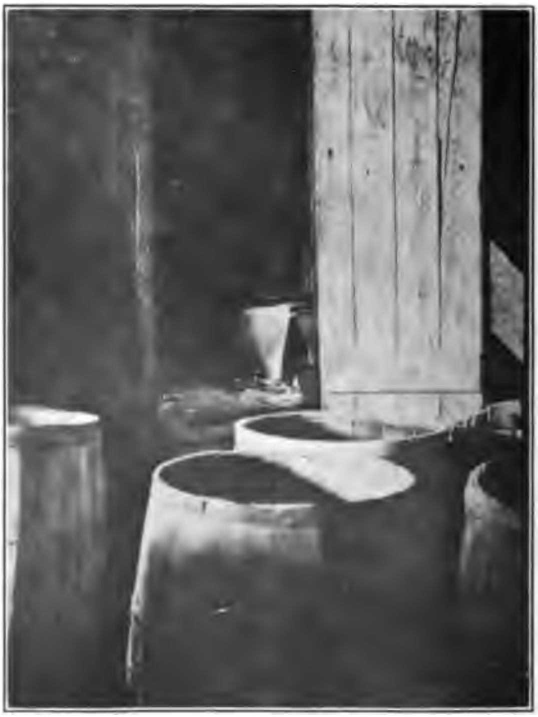

FIG. 28.—TOILET ROOM. TWO MINUTES' EXPOSURE, THIS ROOM BEING VERY DARK AND POORLY LOCATED.

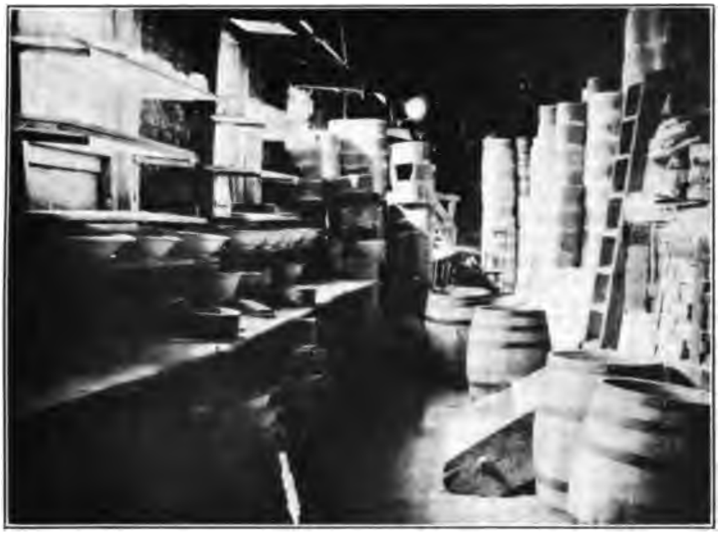

FIG. 29.—WORK BENCH IN GLOST KILN ROOM. NOTE CONGESTION AND POOR ILLUMINATION.

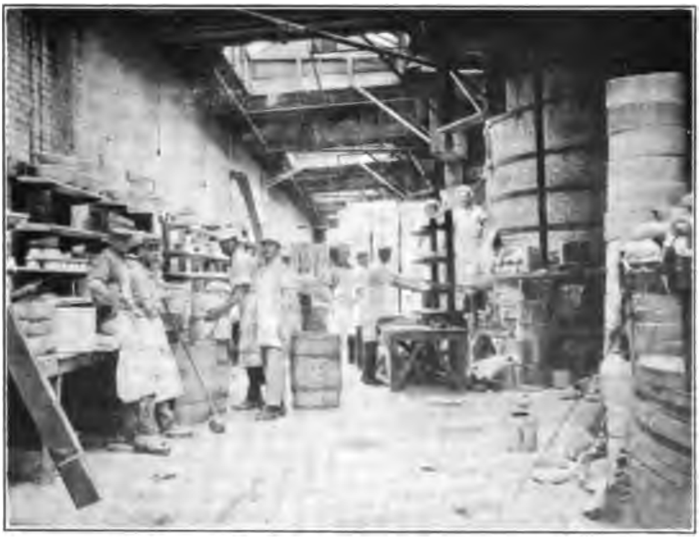

FIG. 30.—KILN PLACING ROOM AND WORK BENCH. NOTE GOOD NATURAL ILLUMINATION AND ABSENCE OF CONGESTION.

PLANT HYGIENE.

NATURAL AND ARTIFICIAL ILLUMINATION.

In this survey both natural and artificial illumination were studied at the place and area according to conditions found in the dipping room, the glaze room, and the kiln room of each pottery. In classifying the rooms as having good, fair, or bad natural illumination, the investigators considered the number of windows, skylights, and doors—whether partly of glass or merely kept open for the purpose of illumination—and carefully noted the number, size, and type of glass in each; whether they were clean, dusty, or dirty; their distribution in various walls; the ratio of light area to floor area; the process; the location of workers; the color of the walls; the amount and nature of obstructions, external or internal; the degree and type of glare, and the position of the workers with regard to light and to the nature of the work.

Of the 75 dipping rooms 30 were classed as good, 20 as fair, and 23 as bad—the respective percentages being 42.6, 26.6, and 30.7.

Of 58 glaze-mixing rooms concerning the illumination of which we have information, 17 are classed as good, 16 as fair, and 25 as bad. Reducing these figures to percentages, we have 29, 28, and 43, respectively.

Of the 65 kiln rooms, 11 were classed as good, 14 as fair, and 40 as bad, the percentage of each being 16.9, 21.5, and 61.5, respectively.

Artificial illumination at best, because of the shortness of the workday and the nature of the work, was not considered of major importance in the analysis of the relationship between such illumination and the possible incidence of lead poisoning. In very few of the rooms did the investigators report the artificial illumination as inadequate.

Differentiation must be made here in the classification of the adequacy of the light, so as to apply the gradation given above only to the plane and area of work and not to the rest of the workroom or to the paths of the workmen, which, according to observation, were not lighted sufficiently to insure the maintenance of a proper degree of cleanliness and other hygienic conditions.

NATURAL VENTILATION.

Seventy-eight plants were classed as having adequate natural ventilation. This classification was made after due consideration had been given to the number of workers in each room, the nature of the work, the size and location of the room, the number of openings (doors, windows, etc.), and to thermometer readings as well as sense perception, at the time of inspection.

Ventilation was provided and controlled by ordinary doors and windows, and by skylights, pivot windows, ventilator windows, air shafts, and air wells, additional fresh air being supplied in many poorly constructed buildings by cracks and openings.

In general, on account of the nature of the buildings, many of them being very old and very poorly constructed, natural ventilation did not seem to be a problem in the pottery industry. In fact, at the time of the survey, the winter temperature in many of the plants inspected was often very near to that out of doors, notwithstanding the various heating systems and devices employed; while in early spring and summer, because of the many windows and other openings in most of the potteries, the interiors were found in most cases entirely satisfactory as far as natural ventilation was concerned, with the exception of dipping rooms and a few small rooms used for special processes. where proper window space and openings were not provided.

In pottery work a very large amount of space per worker is necessary, because of the space needed for the various drying racks, molds, saggers, and other equipment; hence it is only in the kiln rooms, on account of the heat from the kilns, the dust from unloading the kilns and saggers, and the poor location or the lack of windows and doors, and in the rooms where the fettling processes and the bisque-ware brushing are carried on, that the need of ventilation from either dust or heat is especially noticed.

It was found in some potteries that the bins in which the clay mixing and glaze mixing were done are located in the basements or cellars of the plants; and that in many of these basements or cellars, on account of the scarcity of windows and doors—most of the windows, too, being only one-half size—and on account of the dampness caused by the processes, the ventilation is often inadequate.

ARTIFICIAL VENTILATION.

The investigators failed to find a single plant which had adequate artificial vertilation for the entire plant or for any particular part or process of the plant. In 12 plants they found either electric fans or machinery that created a certain amount of air motion, but this could not be considered adequate artificial ventilation. In one or two plants exhausts for fettling and bisque brushing were found. In several others revolving machinery caused a certain amount of air motion, and a few kiln-placing crews used electric fans in and around the kiln when they were loading the saggers or were removing and unloading them. These fans in most instances merely stir up the air and dust, without causing any exchange of air. In one plant was found a 3-foot fan and pipe system which originally pumped air into the glaze-mixing room; but this system had not been in use for a long time, and the investigators were informed by the foreman that it was to be taken out, because when in use it shook the floor above too much. It was thus found that little attention had been paid to the installation of adequate artificial ventilation, in those processes and workrooms in the potteries where its installation was essential.

HEAT, COLD, AND WET HAZARDS.

Heat, cold, and dampness were found by the field investigators to be negligible factors in the production of lead poisoning, except in a very small number of sanitary-ware plants, where enamelers and helpers are exposed to heat from the furnaces and the glowing metal, in the constant handling of heated ware when removing it from the furnaces, placing it upon the workbenches, and applying the enamel. The heat is quite intense, and little ventilation is provided in these plants. The men perspire freely, and when possible rush to the doors and other openings for fresh air. Such exposure to heat is naturally greater in warm weather, but the extremes of heat and cold are more of a risk in cold weather.

The faces of many of the men appear as if sunburned. Little clothing is worm by those engaged in this work, so that their bodies are subjected to many sudden changes of temperature. Practically all the men wear asbestos gloves on the hands nearest the heated ware, for the protection from the radiant heat.

The conditions found in the kiln rooms, in firing, drawing, or loading the kilns, do not present serious heat hazards. The temperature is high, but not dangerous. A heat hazard arises in drawing the kilns, when the employees, for the sake of increasing their compensation, insist on drawing the kilns before they have had time to cool. This, however, is not in the regular course of their occupations and can not be classed as a heat hazard existing in the normal production of pottery.

In certain old and poorly constructed buildings cold is a hazard only in so far as it is made one by the weather conditions. This statement applies also to plants where the toilet facilities are located in outhouses and where no protection from the weather is provided by covered passageway or in other ways for the workers as they go to and from the toilets.

Because of the bodily activities required by most processes in the pottery trade—and increased by the plan of compensation by piecework—likelihood on the part of the worker to take cold while in the plant is very slight; and it is for this reason that cold can not be classed as a hazard in the industry.

In sanitary-ware plants, dippers and dippers' helpers in dipping constantly cover their hands and forearms with glaze. This is the only essentially wet hazard in the pottery industry.

In some plants leakage from the mixing machines, together with the natural dampness of basements with earthen floors, keeps the footing damp and often wet.

These hazards are found frequently to exist in the lead processes, but are not inherent to them.

EXHAUSTS AND HOODS.

. The installation and maintenance of exhausts and hoods, which are greatly needed, are sadly neglected, only 11 plants out of 92 having systems of this nature.

The few exhausts and hoods in use, while fairly satisfactory for their particular purpose, are for special processes only; but there are operations where exhausts and hoods could and should be employed. Typical instances of such use are cited from several plants.

GLAZE CLEANING.

After the glaze has dried on the dipped ware it is removed from the foot of every piece. This work is done on uncolored bone china and Belleek ware by placing the piece of ware bottom side upward on a revolving wheel situated over a down-shaft bench exhaust system, which carries away particles of glaze removed from the foot of the ware by the use of the scraping tool. A 4-inch galvanized-iron shield for down-draft exhaust 20 inches in diameter is placed about the wheel. This exhaust system is produced by a three-fourths horsepower motor. The draft is sufficient to carry away all the particles which are thrown off centrifugally by the ware as it is cleaned on the revolving wheel.

WARE CLEANING.

Ware cleaning is done on a bench near the dipping tubs, and consists in removing the excess glaze by scraping or sponging.

Two revolving tables about 2 feet in diameter are located on the bench, and on each table is a thick soft pad. Here the ware cleaner places his ware and revolves it as he cleans it on each side. At a distance of 1 or 2 feet in front of the ware cleaner's bench is the opening of the exhaust from a 22-inch fan, which effectively removes the greater part of the dust generated.

WARE CLEANING OR FETTLING.

Fettling—a process used only for small dishes and cups—is done after the glaze has thoroughly dried, and the dust from this source is very effectively removed by local exhaust systems. A revolving disk, on which there is a piece of rough carpet, removes the excess glaze as each piece of ware is brought into contact with it, and a small exhaust fan draws the dust downward through a 6-inch line into a collecting box in another room.

AUTOMATIC DIPPING AND CONTINUOUS KILNS.

Where automatic dipping and the continuous kilns are found the exhaust fans are connected with the furnaces to carry off the smoke, fumes, and gases, so that the incoming air is not vitiated in any way.

FATIGUE.

There are certain processes in the pottery industry where, because of speed, cramped posture, heavy lifting, and climbing, a fatigue hazard may be present. This is especially true in the case of cup finishers, biscuit brushers, and dressers. The element of posture enters in the case of these workers, in that cup workers stand or sit in a bent-over position all day long, while biscuit brushers and dressers sit on low stools and continually bend over to take pieces from one side and place them on the floor on the opposite side.

In the kiln room and among kiln workers the fatigue hazards are heavy lifting and carrying, constant standing and climbing ladders with heavy loads on the head. The effect of all these fatigue-producing conditions is influenced by the length of the period of uninterrupted activity. Sagger loaders do not work for long hours nor for unbroken periods on the heavy part of their work; dippers and ware gatherers adjust their own rest periods; but those working in cramped positions are so employed for longer periods of time, and therefore come more within the field of fatigue-producing conditions.

AIR DUSTINESS.

Hazards from dust are the bane of many industries. In all potteries dust is present in greater or less quantities. This is shown by the following table of the number of dust particles per cubic foot of air in the glaze mixing, dipping, and kiln rooms, as found by our field men.

TABLE XIX.—*Distribution of dust samples by room according to number of particles, weight, and lead content.*

Rooms.	Number of particles per cubic foot.														
	Class 1.		Class 2.		Class 3.			Class 4.			Total.			
	0–5,000	5,000 plus.	0–10,000	10,000 plus.	0–500,000	500,000–1,000,000	1,000,000 plus.	0–500,000	500,000–1,000,000	1,000,000 plus.	0–200,000	200,000–500,000	500,000–1,000,000	1,000,000 plus.
Glaze mixing	.....	.....	.....	.....	40	0	1	20	8	14	12	6	8	15
Dipping	.....	.....	2	.....	128	4	4	83	13	48	36	46	15	41
Kiln	1	.....	3	3	102	2	5	53	26	30	25	25	27	32
Others	.....	.....	.....	.....	5	0	0	3	0	2	2	1	0	2
Total	1	.....	5	3	275	6	10	169	47	89	75	78	50	90

TABLE XIX.—*Distribution of dust samples by room according to number of particles, weight, and lead content*—Continued.

Rooms.	Weight per cubic foot of air.															Breathes per day 135 feet.						
	Total, in milli-grams.			Lead, in milli-grams.			Soluble lead, in milli-grams.			Per cent lead.			Per cent soluble lead.			Number of particles.				Amount soluble lead.		
	0–0.09	0.1–0.49	0.5 plus.	0–0.09	0.1–0.49	0.5 plus.	0–0.09	0.1–0.49	0.5 plus.	0–9.9	10–49.9	50 plus.	0–9.9	10–49.9	50 plus.	Less than 10,000,000.	10,000,000	500,000,000	1,000,000,000	Less than 1 milligram.	1–4.9	5 plus.
Glaze mixing	12	21	11	32	2	1	36	2	2	15	16	2	21	18	2	3	34	2	2	13	15	13
Dipping	86	67	7	135	1	0	140	3	2	83	48	3	90	50	5	17	92	3	12	69	63	10
Kiln	60	57	13	114	1	0	119	1	0	83	26	2	97	21	2	11	87	4	7	74	44	4
Others	5	0	0	5	0	0	5	0	0	5	0	0	5	0	0	1	4	0	0	3	2	0
Total	163	145	31	286	4	1	300	6	4	186	90	7	213	89	9	32	227	9	21	159	124	27

When using the Palmer spray machine and the corresponding method for classification, the number of class 4 dust particles per cubic foot of air should not average over 200,000 dust particles and must not exceed 300,000 dust particles.

It is not our intention to point out the relation of dust to tubercular and other respiratory diseases, since our interest is concentrated on air dustiness in the pottery industry in its relation to the causation of lead poisoning.

Class 4, dust particles are about 0.0001 square millimeter, those of class 3 are four times as large, those of class 2 are 0.01 square millimeter, and those of class 1, 0.04 square millimeter.

In considering the dust here, we will discuss the total number of particles found, because it is on the total sample that the analysis of the second section of the above table is computed, and it is from the solid particles of dust that the amount of lead is computed. It will be noticed that 75, or 25.6 per cent of a total of 293 samples reported, contained less than 200,000 dust particles—the desired maximum; and that 78, or 26.6 per cent of the number of samples, contained 200,000 to 500,000 dust particles, which is a very wide range for permissible air dustiness. Therefore, 47.8 per cent of the air samples contained a number of dust particles beyond the widest ranges permissible, proving that almost one-half of the potteries are suffering from excessive dust.

Of the total number of samples collected in each division of the pottery workrooms it will be noticed that the glaze-mixing room has the largest per cent in the 1,000,000 plus column under "total"—15 samples out of a total of 41; and that the glaze-mixing room also has the highest per cent of samples having a total weight of 0.5+ milligrams.

Throughout the table the glaze-mixing room ranks first; but on account of the shorter time of their exposure, the rate of plumbism of the glaze mixers is second, that of the dippers being first.

The following paragraphs briefly describe the exposure to dust of the principal classes of workmen.

In some plants the processes are well separated, so that workers in one process need not be affected by the dust produced by adjacent processes; but such plants are in the minority.

DIPPING.

Dippers and dipper's helpers are exposed to the glaze dust generated in the dipping room. The dipping rooms often have rough floors and walls, of either wood or brick, though occasionally cement dipping floors for the tubs are found. Glaze is splashed upon the workers, the floors, the tubs, and walls. It accumulates on the ware boards, and rough handling of these boards—especially dropping them down on end—probably produces more dust in the dipping room than any other operation. This, and the constant movement of the workers, the passing in and out of the glost placers and ware gatherers as they remove the ware from the racks, and sweeping are the chief sources of dust. It was observed that in most of the dipping rooms sweeping raised more dust than it raised in any other department of the pottery.

KILN PLACING.

Glost-kiln placers not only handle the ware covered with dry glaze, but also remove by the rubbing process excess glaze from the feet of the ware which they place. In many plants we found the workers rubbing the ware on their aprons and thus creating a dust highly charged with lead. This work is done at their temporary workbenches alongside the kiln. The kiln men are also exposed to the poisonous dust in various other ways. Dust is stirred up by handling the ware boards and filled saggers, it is raised from the floors by walking and by sweeping, and the men are continually carrying it on their clothing, and often brush the dusty clothing against their heads and faces. In the kiln rooms glaze dust is constantly in the air, and the workbenches and floor are usually covered with dust.

The air dustiness is increased by certain careless practices of the workers; for example, in many plants field men saw pottery workers brush to the floor the dust that had fallen on their benches, thus causing clouds of dust to float in the air. Apparently the practice is a common one, for the wiping of the workbenches with a damp cloth, or by any other hygienic method, was seldom observed in the plants.

The glaze dust found in the kilns after burning the ware does not contain soluble lead—a fact proved by experiments in the laboratory with samples taken from the kilns and by putting samples of glaze through the glost kiln and later analyzing them for soluble lead.

SAGGER WASHING.

The sagger washer paints part of the new saggers with thick glaze, but the spillage is only slight and occurs only on the workbenches. In carrying glazed saggers the worker wipes some of the glaze off on his apron, but the amount of glaze dust in the air from his operations is probably very slight. However, the sagger washer is usually subject to increased hazard from lead, because his working place is usually quite close to the dipping or kiln room or connected with it and ventilated through it. He is usually located in or near a passageway traversed a great deal by the placers, with either empty or loaded ware boards. As the sagger washer is usually close to the dipping or glost-kiln room and works during longer hours than dippers and kiln men, he is therefore exposed to the dust raised in sweeping the dipping or glost-kiln room.

GLAZE MIXING.

In addition to these constant and regular processes where dust is a continuous hazard, the process of mixing glaze produces more or less poisonous dust by the assembling, handling, loading, and dumping of the lead components into the mixing vat and by continual walking on the dirty floors.

SWEEPING AND DUST CONTROL.

The following methods of sweeping were employed in the various plants: (1) The floors in 19 plants were swept dry. (2) In 73 they were usually sprinkled with water before sweeping. (3) In some they were washed down with water. (4) In 9 plants the floors were strewed with dry sawdust and then were sprinkled or swept dry, and in 24 plants oiled sawdust was sprinkled on the floors and removed at will.

A few plants had special rules concerning the sweeping of the floors and the methods to be employed, and some plant managers and dippers were very careful and had the floors washed with water or sprinkled with oiled sawdust as often as necessary, and did not permit sweeping while the workers were about; while in others there seemed to be no regard for the hazard, and the employees were allowed to sweep the floors at will and in any manner they desired, without regard to the amount of dust raised and the dangers of the dust. In some plants the floors were swept three times a day, and in others only once a week.

In a few plants the men were found to use respirators while sweeping, but in the majority the sweepers used no means of protection whatever.

In 47 plants it was found that sweeping was done during working hours; and in 25 of these the floors were swept dry or only slightly sprinkled, clouds of dust arising during the process.

In the glost-kiln rooms sweeping and cleaning were done after each kiln was loaded, and in the mixing rooms after each batch of glaze had been mixed.

Tables of dust counts according to workrooms is found in Appendix E.

PERSONAL SERVICE FACILITIES.

WASHING FACILITIES.

In the entire survey, covering 92 plants, there was not found a single plant that provided a separate and modern wash room for the use of the employees. In 5 plants shower baths were found, and 20 plants provide hot and cold water for the use of the employees; 4 plants furnish soap and towels; 29 plants provide troughs of some type for washing; and 37 plants have pails that are available for washing purposes; 9 plants have some other form of washing facilities, including tubs, etc.

In many of the plants the workers wash either in basins or bowls removed from the racks, or in troughs used for washing the ware and the ware boards; and in quite a number of plants the dippers and dippers' helpers are known to wash their faces and arms with the sponges which are used in cleaning the sides and edges of the dipping tub.

In general, the washing facilities are scanty and inadequate, and because of this condition the employees wear their work clothes from the plants to their homes and vice versa. The ratio of washing facilities to the number of employees is from 1:4 to 1:45. Many workers were observed to eat with unwashed hands.

In many plants the glaze washed from the ware boards is collected in troughs and tubs for reuse; washing with soap is not permitted at faucets over these troughs and tubs, because the soap would ruin the glaze. Consequently, in some such plants, in which no other faucets are provided for washing, soap could not be used, unless the worker himself make other arrangements for washing.

LOCKERS.

Twenty plants have lockers of some sort, made of either wood or steel; while only one plant has a regular locker room, and 13 other plants have change rooms. The lockers in five plants are in the work rooms. The ratio of employees to lockers, in plants where lockers were found, ranges from 1 :1 to 3 : 1.

In 66 plants the street clothing of the workers was found in the workrooms during working hours. In 22 plants some form of protective clothing—aprons, respirators, masks, or overalls—are worn by the employees.

Where the employees change their street clothing in the workrooms the want of lockers leads to the continued exposure of street clothing—as well as of food and tobacco—to lead dust as long as they are in the plant. Because lockers and locker rooms are not provided the employees in many cases wear their work clothes from their homes to the plants and back again and in this manner carry lead dust into their homes.

WATER SUPPLY AND DRINKING FACILITIES.

Seventy-two plants have city water supply, while in 13 there are local plant wells. Only a few plants are without water supply and have to obtain drinking water from wells located on other property.

Water for drinking purposes is obtained from faucets in 52 plants, in 19 from pails only, and in 18 more from pitchers only, this water being placed at various points in the workrooms. Very few plants have "bubblers," or fountains, and only 2 have water coolers in use in the warm weather.

It is not our purpose to discuss here the utensils through which the water reaches the employee, since the subject is taken up more fully under "Plant welfare." We will call attention, however, to the small number of plants in which individual drinking cups are supplied. Even where individual drinking cups are used, they are not always protected from lead dust and other dangers of insanitation. The illustration below shows the uncovered drinking cups hanging with the mouths of the cups upward, so that the dust from the room, can readily settle in the cups as they hang from the hooks.

Uncovered pitchers of coffee and of water and open cups were found standing on shelves, and often a scum of dust was found on the contents of the pitchers. Liquids exposed in this manner, and doubtless containing lead dust, can not be considered safe for drinking purposes.

TOILETS.

While the greater part of these potteries are within city limits, our investigation shows only 27 connected with any sewer system. Privies were found in use in 12 of the plants. Septic tanks, cess pools, and drains into neighboring streams were found in various plants. Stream pollution and contamination of water supply were found in connection with several plants.

The ratio of the number of toilets to employees varies from 1:4 to 1:57 and the distance from place of occupation from 25 to 525 feet.

The toilets vary from the most modern type of autoflush tile toilets to the most repulsive and insanitary type. They are distributed as follows: 18 hopper toilets, 9 wash down, 17 siphon, 27 flush, 10 autoflush, and the remainder the old common privy type. In 23 plants the toilets are on the second floor; in 66 the toilets are inside the plants, and in 23 plants they are outside. In 17 plants the toilets are exposed to all weather conditions. In 36 plants the toilet facilities are classed as good and in 43 as bad.

Most of the toilets are within a reasonable distance of the place of work, and are usually of such nature and condition that they could be classed as good or bad, though a few are beyond each extreme.

The compartments are usually of sufficient size, and are well ventilated and heated. A few were found with only artificial illumination.

In some plants where the toilets are in outbuildings the passageways to them are inclosed; in others no protection whatever is afforded the worker in passing to and fro.

In the toilets classed as good the number of stools and urinals and the light, heat, and ventilation are satisfactory.

Toilets that are classed as bad are so classed because of broken or missing toilet seats, constantly running water, flush out of order, lack of heat, ventilation, or light, dirty floors and walls, insufficient number of stools and urinals; if in outbuildings, no protection from exposure to weather. Some are old wooden outbuildings, on the banks of streams or in the open, with no means of cleaning; some have seats formed by nailing upright boards on the floors in the shape of a V against the rear wall. Many are not screened, and no method is used to keep out flies or to prevent odors.

In some of the plants toilet facilities are modern in every respect, but the picture inserted below shows the lack of care and interest taken in them. The walls are dirty and marked in every conceivable fashion; the floors, walls, and doors were covered with dust and dirt. The cause of this may be that the companies expect the employees to care for the rooms and do not provide attendants.

CLOTHING.

In only 22 plants do the employees wear any sort of protective clothing, such as aprons, overalls, masks, respirators, etc.

In the majority of the plants, and in all processes of these plants, all clothing is worn from the home to the plant and throughout the day while at work.

In many plants the clothing is changed and hung on the wall near the place of occupation without regard to the dust that would settle on the clothing.

The kind of clothing that should be worn and the care of it are questions left entirely to the employees. The plant owners, apparently uninterested in protective measures in regard to this matter, permit the clothing to be changed in any section of the plant, and consequently to become contaminated with dust.

CUSPIDORS.

Only one plant out of 92 provides cuspidors; positive evidences of expectoration on the floor were found in 68 plants. There seems to be no regard to instructions given concerning this insanitary and dangerous habit.

PLANT MANAGEMENT IN RELATION TO WELFARE OF WORKERS.

Our field investigators gathered as much information as possible concerning the management and welfare of workers, but on account of the almost universal absence of any plant records concerning these matters this information is very meager.

EMPLOYMENT.

No employment bureau existed in any of the plants at the time of the investigation. Each foreman hired his own men. In many of the plants the employee is engaged by the piece, and is interested in turning out as large an amount of the finished product as possible. The foreman has no supervision over those who do not come directly within his department, and practically no interest in them. With the power to hire there comes also the power to "fire," so that each foreman may discharge an employee in his particular department without consulting the general plant management. Frequently the foreman of the dipping room, for example, is paid by the company for the weekly product which passes through his hands for the purpose of receiving a coat of glaze. Out of this amount he in turn pays the other dippers and helpers, and no regular records are kept of the personnel nor of the amount of the individual wages paid. Thus there are no records by which a turnover might be computed. Frequently there is no record of the exact number of people employed. The nearest estimate is obtained by going over the pay roll of each foreman. A few employees who do not come directly under the supervision of the foreman of a given department are employed by the superintendent. Matters of dispute between union members and the management are referred to a standing committee of manufacturers and union men.

TRAINING.

About two-thirds of the plants included in this survey have a system of apprentice training, which is regulated by the unions rather than by the management of the plants. The usual time required for an apprentice is three years, although in some departments four years is required; yet the necessary skill can be obtained in most cases

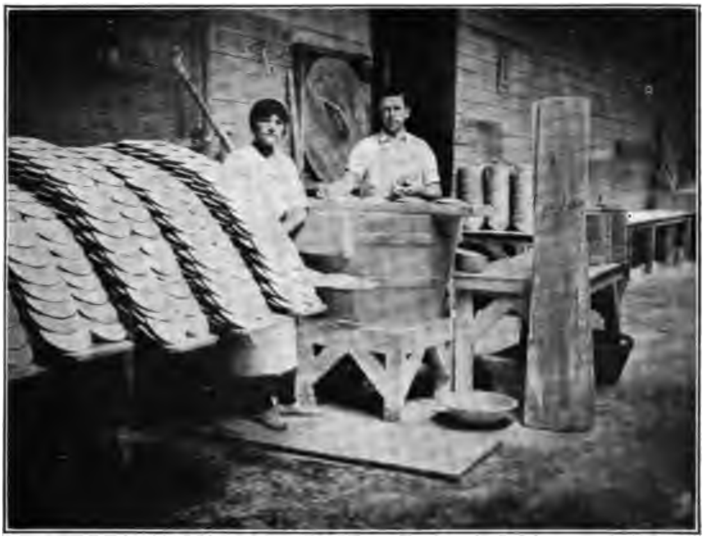

FIG. 31.—DIPPING. NOTE GLAZE ON FOREARMS OF THE DIPPER. HANDS OF DIPPERS' HELPERS ARE ALSO COVERED FROM HANDLING THE WET DIPPED WARE.

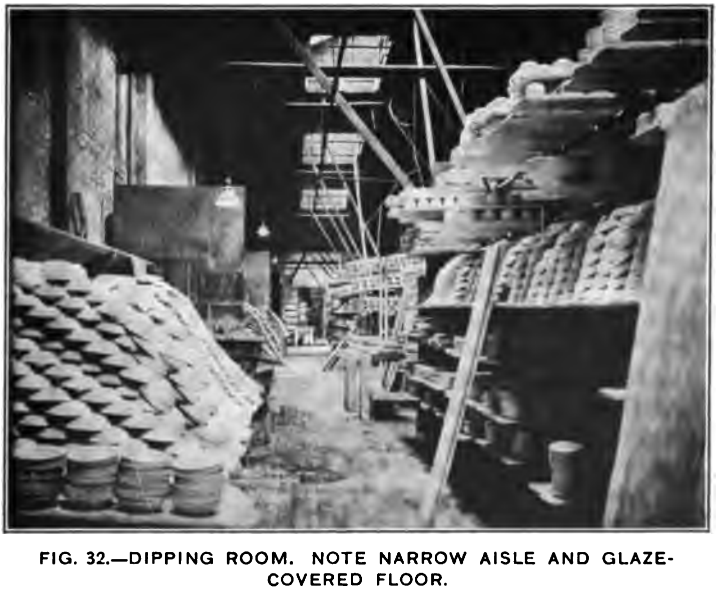

FIG. 32.—DIPPING ROOM. NOTE NARROW AISLE AND GLAZE-COVERED FLOOR.

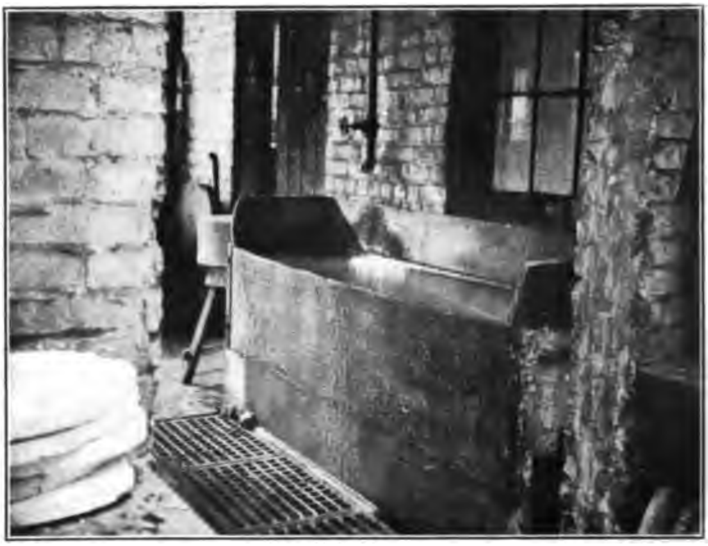

FIG. 33.—TROUGH FOR WASHING WARE BOARDS. THE ONLY AVAILABLE WASHING FACILITIES IN THIS PLANT FOR GLOST KILN PLACERS AND DIPPERS.

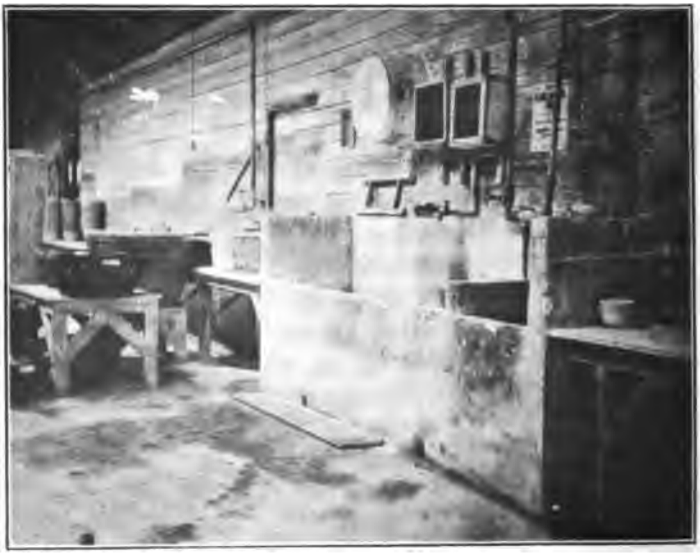

FIG. 34.—TROUGH FOR WASHING WARE AND DRAIN BOARDS. ONLY WASHING FACILITIES AVAILABLE IN THIS PLANT FOR KILN MEN AND DIPPERS.

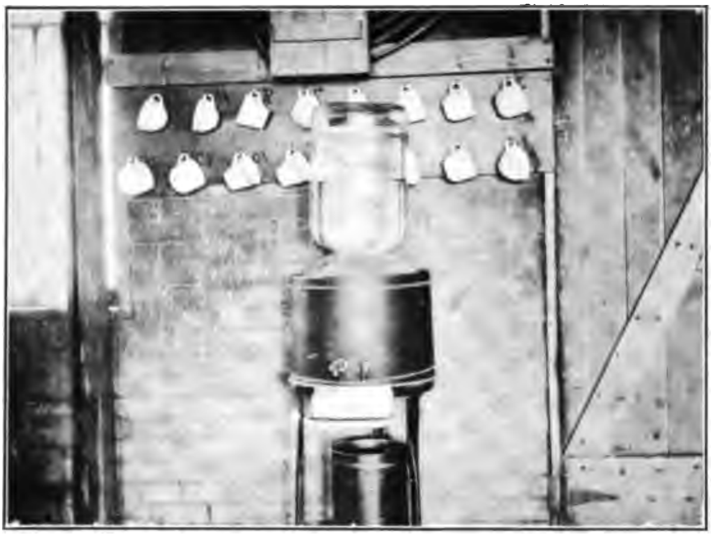

FIG. 35.—DRINKING FACILITIES IN A PLANT SHOWING INDIVIDUAL CUPS, SO ARRANGED AS TO CATCH ALL DUST AND OTHER MATERIAL IN THE AIR.

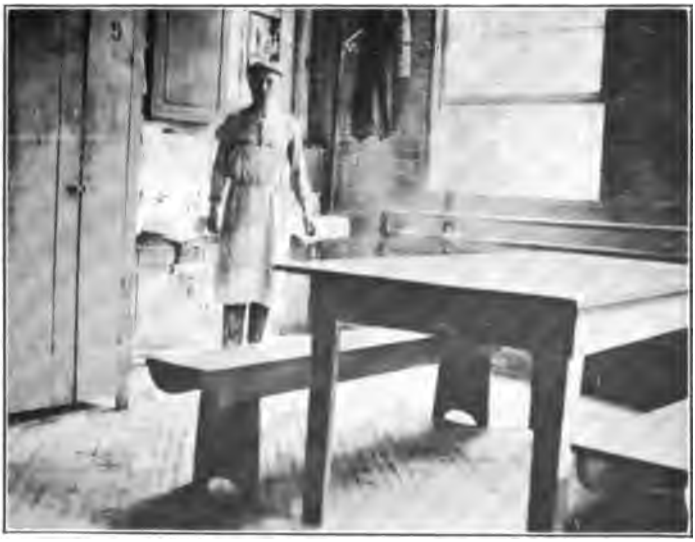

FIG. 36.—SHOWING ONE ROOM USED AS CHANGE, LOCKER, AND LUNCH ROOM FOR USE OF GLAZE MIXERS.

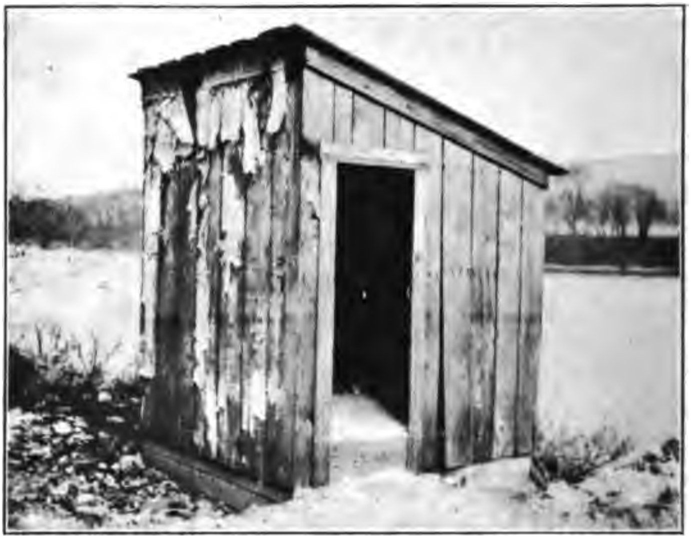

FIG. 37.—OUTDOOR PRIVY FOR MEN, CONTAMINATING STREAM OF WATER.

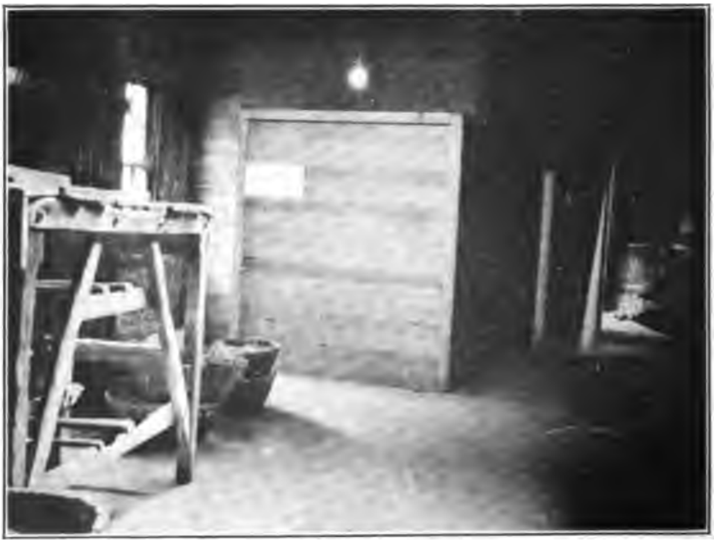

FIG. 38.—SCREENING OF THE DOORS OF THE TOILETS IN A PLANT HAVING EXCELLENT TOILET FACILITIES.

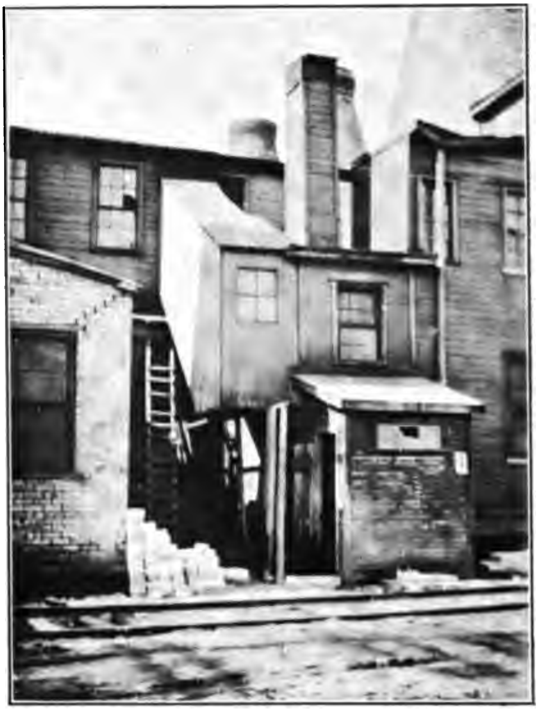

FIG. 39.—TWO-STORY TOILET.

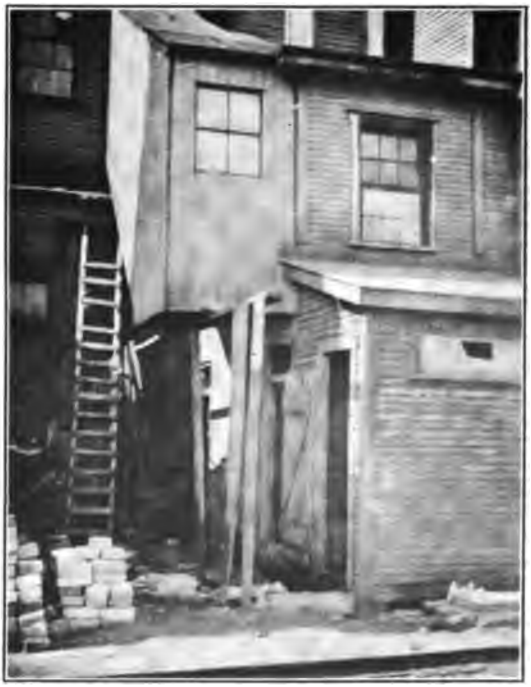

FIG. 40.—CLOSE-UP OF TWO-STORY TOILET. UPPER SECTION FOR WOMEN, LOWER FOR MEN. THIS TOILET IS A NUISANCE AND A HEALTH HAZARD.

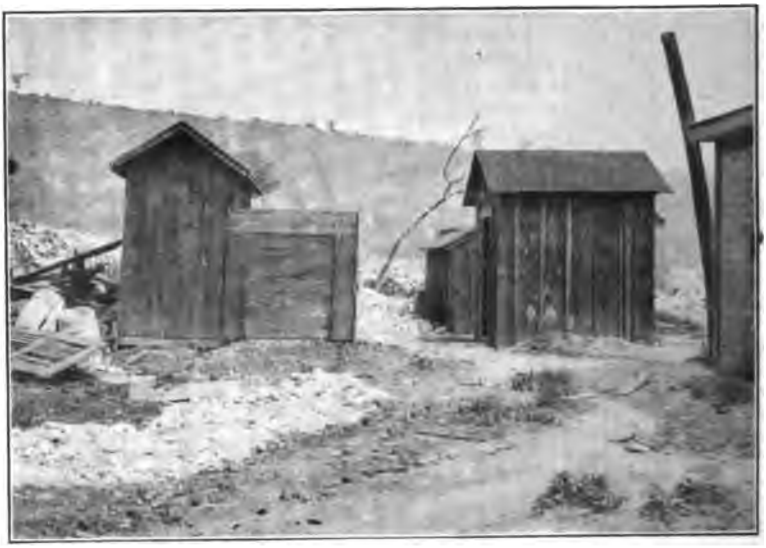

FIG. 41.—COMMON OUTDOOR TOILET. NOTE CONSTRUCTION AND UNTIDY SURROUNDINGS.

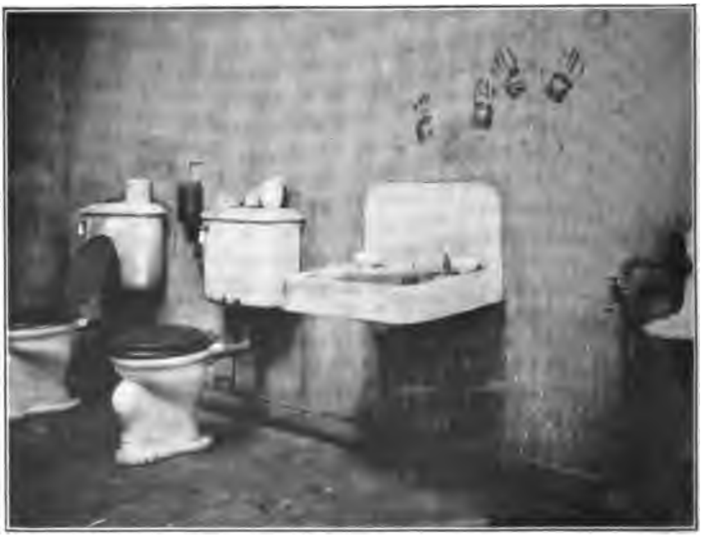

FIG. 42.—MODERN TOILET, SHOWING LACK OF CARE, EITHER DUE TO WORKMEN OR LACK OF INTEREST ON THE PART OF PLANT MANAGEMENT.

within six months. One plant was found which had had a training school before the war, and another was found where training is given by the foreman. In a great many instances learning the trade seems to be left to the desire of the employee, and he acquires his knowledge from information and voluntary instruction given by his coworkers.

MEDICAL ATTENTION.

In only one plant out of the 92 was there found any attempt at medical supervision. In 42 plants some form of first-aid cabinets was found, and in eight plants certain individuals are assigned to render first-aid work. In spite of the hazardous processes carried on, it seems that there is an almost complete lack of medical attention. American potteries appear to be very much behind foreign establishments, where through medical attention cases of lead poisoning are discovered in the early stage, and by proper care loss of time and of efficiency on the part of the worker is prevented.

Our investigators found that there are no examinations of workers on the part of the management; no opportunities for the examination and care of teeth, no company hospitals, and in the whole survey only two dispensaries were found.

The plants in West Virginia and Pennsylvania and the few in Ohio are required by the States to keep accident records; one plant keeps a record of severe accidents; two plants were found which keep sickness records for some workers, and one which keeps sickness records for benefits only; one plant was found which keep records for first aid only. The teaching of hazards is not practiced in a regular way. One plant was found which teaches the hazards to some workers; four were found using placards; one giving instruction once a month; one every three months. As a general rule there is an almost utter lack of records of all kinds, and of training and instruction as to lead hazards.

The Brotherhood of Operative Potters have a practical potter as health officer, whose duty is to cooperate with the plant managements toward the welfare of the workers and to arrange for medical care of the workers when they become ill. He has taken many employees from the potteries to the clinics of neighboring hospitals.

The Brotherhood of Operative Potters has installed in hospitals in two cities the Clague Oliver electrolytic apparatus, but comparatively little use has been made of the device. Opinions on the efficiency of this treatment are found in Appendix A.

HOUSING.

The locations of the potteries covered in this investigation are such that the workers may occupy homes in the city or the country, since both are easily accessible. Only one plant was found which furnishes employees with homes for which a reasonable rent is charged.

OTHER WELFARE WORK.

Rest rooms are found in seven plants; plant restaurants in eight. The typical plant in this survey, however, has no welfare facilities and no welfare work. The attitude of the plant managements is usually favorable toward these things, and there seems a willingness for cooperation; but the lack of definite placement of responsibility, owing to the system of employment in practice, seems to prevent not only satisfactory welfare work, but, as will be shown later, satisfactory observance of the rules of plant hygiene.

DISCIPLINE.

No conscientious effort was noticed in any plant to enforce rules which would diminish the number of cases of plumbism. Promiscuous spitting is practiced in most places. Discipline, together with instructions pertaining to the health hazards, is absent.

SICKNESS AND ACCIDENT INSURANCE.

A great many of the plants studied are subject to the workmen's compensation laws of the various States. Local unions also give hospital care and pay death benefits to their members. Only six plants were found which carry any kind of insurance for the employees besides the protection furnished by these organizations.

REST PERIODS.

In most plants a rest period of from 15 to 30 minutes is allowed in the middle of the forenoon. Taking advantage of this is optional, however, with the workmen, and is not favored by those who are on piecework. Few avail themselves of this rest period, even to the extent of using it as a lunch period. Pieceworkers, as a rule, either eat while working or wait until they have finished the day's work.

REST ROOMS.

According to previous statement, only seven of the 92 plants surveyed maintain rest rooms, and even these few are, for the most part, poorly adapted for their purpose. The rooms available for rest were in most cases very small, usually of unclean and uninviting appearance, and poorly kept. The furnishings are meager and uncomfortable. They are not truly rest rooms in any sense of the word.

EATING REGULATIONS.

The managers of most potteries apparently feel that the lunch period belongs to the worker and that they have no concern in it. In only five plants do we find any regulations against eating in workrooms, and in three of these the regulations are not observed. Our investigators noticed that the workmen not only make a practice of eating in workrooms where glaze and lead dust are present, but that they wash their hands either carelessly or not at all. Even workmen who come in contact with the glaze are negligent in this respect. In 80 plants some workers eat in the workrooms, and in 65 of these a majority of the workers do so, involving 969 workers, or over one-half of those examined in this survey.

In one plant a woman worker whose hands were covered with glaze was observed eating a piece of pie. Between bites she placed the pie on a ware board covered with glaze. A foreman, noticing this, reprimanded her, but on account of the system of employment and discharge which prevails in the potteries he could not enforce his reprimand. This is not an isolated instance, for similar carelessness was observed in many plants; eating in workrooms was reported in 80 out of the total of 92 plants surveyed.

Regulations as to washing are urgently needed in most of the plants and should be strictly enforced. Reference to the tables on the dust counts made in these rooms is convincing enough that lead is present in the dust in sufficient quantities to warrant absolute restrictions against eating in the workrooms where such dust is present. Our investigators find that the plant restaurants in existence are well patronized.

MILK SUPPLY.

Some workmen drink milk as a prophylaxis against plumbism. While a study of the effect of milk drinking is reserved for a later part of this report, the statement may be made here that the use of milk has generally been recommended by physicians. Great care should be taken, however, that the milk is not exposed to lead dust or placed in vessels in which lead may be present. Our investigators did not find a single plant, however, in which the management was in any way responsible for furnishing the milk supply.

PRACTICES INVOLVING PERSONAL HABITS.

It was found that smoking and chewing tobacco are practiced to an unusual extent among the workers in the pottery industry. Chewing furnishes an especially fruitful means of introducing lead-laden dust into the stomach. The plug of tobacco is frequently carried in an unprotected pocket and is handled with unwashed hands, so that there is plenty of opportunity to get portions of glaze and of lead dust with each chew. A peculiar idea seems to exist among potters to the effect that chewing, smoking, and liquor drinking are prophylactic aids to prevent lead poisoning. In some potteries the idea prevails that if the worker gets dead drunk on Saturday night he will vomit most of the lead ingested during the week. On the contrary, alcohol lowers resistance and increases personal carelessness, and therefore predisposes to lead poisoning. The effect of these habits was ascertained by investigation, and the rates of plumbism among users of tobacco and liquors will be given in Part IV of this report, where a careful analysis of each is made.

PART III.

LEAD AS A POISONOUS SUBSTANCE.

FORMS OF LEAD COMPOUNDS KNOWN TO BE POISONOUS AND THEIR RELATIVE SOLUBILITY.

The amount of lead which ultimately takes part in damaging the vital organs and tissues is measured by the solubility of the lead in the body fluids, the chemical constituents of these fluids, the facility with which the tissues absorb the particular compound, the amount and the nature of the food in the stomach when the portal of entry is by way of the gastrointestinal tract, the mode of entrance into the body, and the susceptibility of the individual. The larger the ingested particle the better its chance of passing through the intestinal tract before solution and absorption take place.

Lead is more readily absorbed from its fumes than from any of its solid compounds. Some of its compounds are more soluble and more toxic than others. In the comparative tables which follow it will be seen that while all these compounds are regarded as poisonous, lead carbonate, which is generally used in the pottery industry, is one of the most toxic, and therefore one of the most dangerous.

Hamilton (*1*).	*Oliver* (*2*).	*Rambousek* (*3*).	*Legge* (*4*).
Lead carbonate.	Lead carbonate.	Lead acetate.	Lead carbonate.
Lead acetate.	Lead oxide.	Lead chloride.	Lead oxide.
Lead oxide.	Lead chromate.	Lead carbonate.	
Lead suboxide.		Minium.	
Red lead.			
Litharge.			
Chrome yellow.			
Chrome green.			
Metallic lead.			

The first table is in order of toxicity, commencing with the most serious. Oliver names only the compounds most important in respect to their poisoning power. He adds that "metallic lead per se has less poisoning power than its salts."

The third table shows the order in which lead compounds were found by Rambousek to be soluble in water or in weak acids (hydrochloric acid of the gastric juice). He comments further that lead sulphate and lead iodide are to be regarded as relatively less poisonous. "Lead sulphide is," he says, "in spite of various assertions to the contrary, practically nonpoisonous—a fact attributable to its

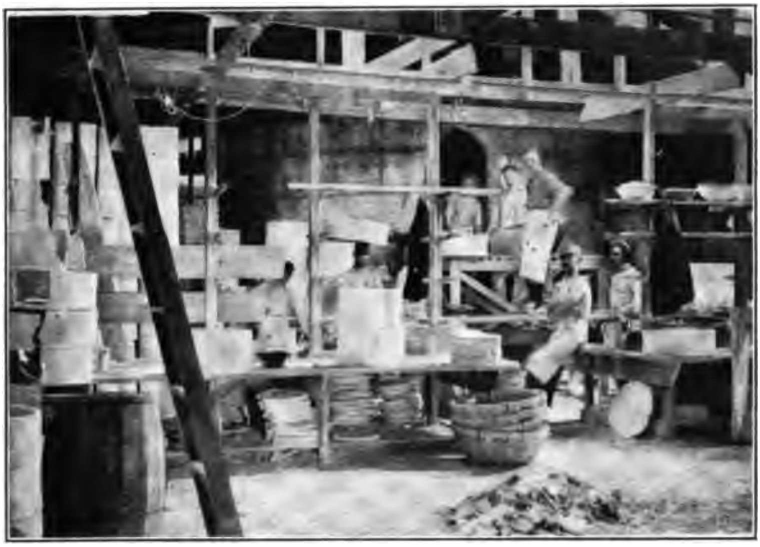

FIG. 43.—SHOWING TYPE OF CLOTHING USUALLY WORN BY THE POTTERY WORKERS.

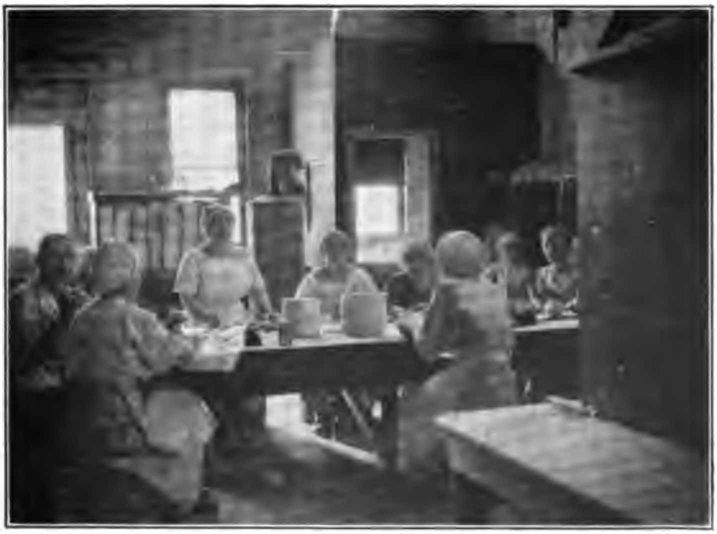

FIG. 44.—SHOWING TYPE OF CLOTHING USUALLY WORN BY THE POTTERY WORKERS. THE WORKERS ARE EATING LUNCH IN THE BISQUE BRUSHING AND DIPPING ROOM. NOTE FOOD IN THE HANDS OF THE WORKERS.

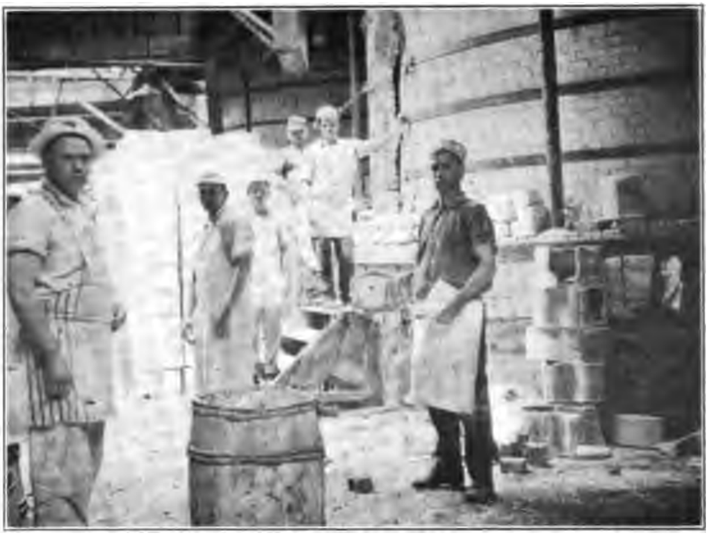

FIG. 45.—SHOWING TYPE OF CLOTHING USUALLY WORN BY THE POTTERY WORKERS.

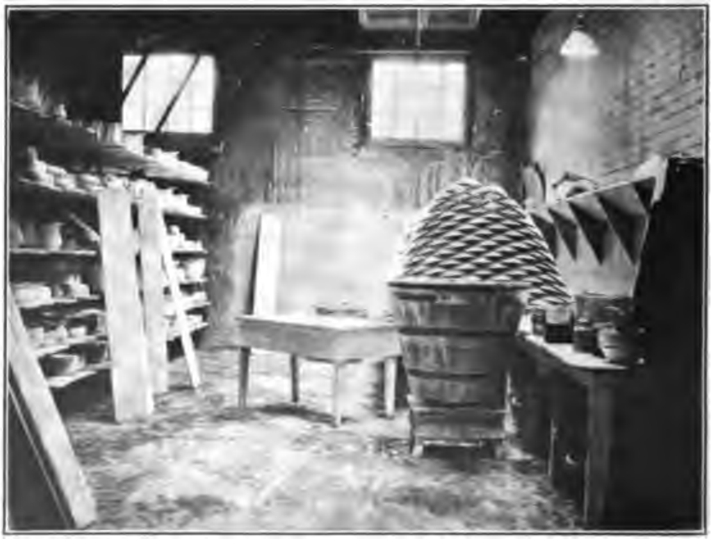

FIG. 46.—DIPPING ROOM. DIRTY WARE BOARDS, GLAZE ON FLOOR, AND DIRTY WALLS. NOTE LUNCH BASKETS ON WORK BENCH AND WRAPS HANGING ON WALLS.

insolubility in water and weak acids. As lead sulphide is the only nonpoisonous lead compound, it is a duty to take advantage of this fact for purposes of lead prophylaxis."

According to Dr. Alice Hamilton (5), the question of the solubility of the sulphide ores was definitely settled by A. J. Carlson and A. Woelfel, of the physiological department of the University of Chicago, who reported the results of their experiments in 1913 on the human gastric juice and the sulphide ores, as showing the average percentage of lead dissolved to be for the pure sulphide, 4.6 per cent; and for the ores from three districts, 1.38 per cent, 2.94 per cent, and 3.32 per cent. (For experiments, see Labor Bulletin No. 120, pp. 22–32.)

Legge (6) lays much stress on air contaminated with lead dust as the important factor in lead poisoning. He states: "The investigations of one of us (K. W. G.) on the experimental production of lead poisoning in animals has shown conclusively that the dust inhaled was far more dangerous and produced symptoms far earlier than did the direct ingestion of a very much larger quantity of the same compound by way of the mouth and gastrointestinal canal. There is no doubt whatever that the chief agent in causing lead poisoning is dust or fume suspended in the air." This is substantiated by the following table of physical examinations among lead workers:

Cases of lead poisoning in dusty and other processes.

Year.	Total number of examinations.	Total cases of poisoning.	Cases in dusty processes.	Cases in other processes.
1905	5,464	9	8	1
1906	5,096	18	16	2
1907	4,303	4	8	1
1908	3,965	4	3	1

TOXIC AND LETHAL DOSES OF LEAD.

Legge (7) estimates the minimum quantity of lead required to produce poisoning as 0.005 gram per kilogram of body weight. "On the other hand," he adds, "persons who have swallowed much larger doses than this have exhibited no symptoms of poisoning." An approximate lethal dose for healthy adults, he states, is probably as large as 50 grams (8) for lead acetate; for lead carbonate, 25 grams. Goadby's (9) results from exposing animals to lead dust were as follows: "Animals subjected to inhalations of lead dust invariably succumbed to the effects of the poison when the dose given represented from 0.0001 to 0.0003 gram per litre of air inhaled, the period of inhalation being half an hour three times a week. On the other hand, when the lead content of the air was as low as 0.00001 gram per litre the symptoms of poisoning were long delayed; and in more than one instance, after an early diminution in weight, recovery of the lost weight took place, and the animals, while showing apparent symptoms of absorption, had no definite symptoms of paresis." Legge and Goadby (10) believe that "if the amount of lead present in the air breathed contains less than 5 milligrams per 10 cubic meters of air cases of encephalopathy and paralysis would never, and cases of colic very rarely occur. About 2 milligrams, or 0.002 gram, of lead we regard as the lowest daily dose which inhaled as fume or dust in the air may in the course of years set up chronic plumbism."

THE LEAD HAZARD IN POTTERIES COMPARED WITH THE LEAD HAZARD IN OTHER INDUSTRIES.

Among industries which give rise to unhealthful occupations potteries occupy a prominent place. With the elimination of the lead hazard the pottery industry will have lost one of its most dangerous features. Rambousek (11) gives the proportion of cases of lead poisoning to those of other forms of industrial poisoning as 20 to 1.

The following table given by Kober and Hanson (12) of Dr. Legge's 6,762 cases of lead poisoning places the pottery industry second in importance among industries where lead is a hazard.

Number of cases of plumbism in the following English industries.

Industry.	Cases.	Industry.	Cases.
White lead	1,295	File cutting	211
Pottery	1,065	Printing	200
Coach building	697	Tinning and enameling	138
Manufacture of paints and colors	422	Manufacture of sheet lead and piping	109
Paints, other industries	452	Red-lead works	108
Smelting of metals	412	Brass works	75
Electric accumulator	285	Enameling iron plates	52
Shipbuilding	269	Glass cutting and polishing	48
Plumbing and soldering in factory premises	217	Lithotransfers	48
		Other industries	659

Dr. Legge says these figures do not include cases among house painters and house plumbers.

PORTALS OF ENTRY AND RELATIVE SIGNIFICANCE OF EACH.

INGESTION.

While it is true that probably most of the lead absorbed gains entrance to the gastrointestinal tract, this does not mean that it is conveyed there only through such habits of the individual as chewing tobacco and eating food contaminated with lead dust, or through carelessness in personal cleanliness. These habits are contributory sources, but the most important source is the fumes and dust which are inhaled and retained in the nasal and pharyngeal cavities and afterwards swallowed with mucus, saliva, and food. The experiments performed on animals by the Japanese pupil of Prof. Lehmann (13) demonstrate that approximately 75 per cent of dust inspired enters the stomach rather than the lungs.

RESPIRATORY SYSTEMS.

PLUMBIFEROUS EMANATIONS.

The question of emanations from the compounds of lead and various glazes is a much disputed one.

J. L. Breton (14), in his book Le Plomb, describes many experiments which he had conducted together with M. Trillat, Dr. Heim, and A. Herbert, and which, he states, "prove the emanations and tension of fumes of the carbonate and oxides of lead."

In our laboratory tests made to confirm the above experiment Chemist Harry W. Houghton, of the Division of Industrial Hygiene and Sanitation, failed to detect lead emanations from lead glazes and compounds used in the pottery industry.

The experiments of Breton and our own experiments are described in Appendix C of the report.

INHALATIONS.

However, the amount of lead absorbed from the lungs is not to be disregarded, and the respiratory tract is an important portal for the entrance of lead fumes as well as dust.

From certain pathological and histological investigations made by Legge and Goadby (15), and from the fact that particles of lead are, as they state, very readily taken up by white blood corpuscles, they conclude that—

> Absorption of the finer lead particles gaining access to the lungs takes place through the medium of these phagocyte cells, as such cells are well known to exist under the alveoli of the lung. * * * Once having gained access to the interior of the cells, the particles subjected to the action of the serum of the blood in the ordinary process of bathing the tissues by the exuding lymph—nay, more, actual particles of lead—may thus be actually transferred bodily into the finer blood spaces and so be carried forward in the general circulation. Such particles as remain fixed in the lungs will undergo gradual absorption, and the constant presence of carbonic acid in the circulating blood brought to the lung undoubtedly largely contributes to the necessity of some recondite interaction of organic acid for the solution of the inhaled lead in the lungs.

Legge (16) quotes Meillere as one of the few authorities who do not consider the lungs an important channel of absorption. He says that absorption of lead dust by the lungs is hypothetical; that it may take place, but that it is not a channel of absorption of practical importance.

THE SKIN AS A PORTAL.

While the absorption of lead through the skin, though a long-disputed question, is now alleged as possible, yet authorities agree that the amount so absorbed is negligible as far as industrial poisoning is concerned. Skin abrasions, however, afford channels presumably favorable to the absorption of lead, yet the amount absorbed in this way is probably too small to be regarded as a factor in lead poisoning. The absorption of lead through cuts and skin wounds is too commonly suggested as the cause of poisoning which has taken place otherwise.

INDIVIDUAL SUSCEPTIBILITY.

All forms of life—both animal and vegetable, with few exceptions—are susceptible to the destructive action of lead. The notable exception among the lower forms of animal life, found in the studies of Mr. T. W. Hogg (17), is the earth worm. The toxic dose for man varies greatly with the individual. It is cumulative in its action, and the amount which, taken at one time, would produce poisoning, would also, if distributed in minute doses and taken daily, be sufficient to cause serious poisoning. In some workers a very short exposure to lead and its compounds is sufficient to cause serious symptoms of poisoning, while others under the same conditions show no evidence of intoxication. It is said that young adults are more susceptible than old, that women are more susceptible than men, and that alcoholism predisposes to lead poisoning.

The statement that females are more susceptible than males is supported by the report of the British Government Pottery Committee (18) appointed in 1908. The report covers a period of 11 years (1899–1909) and shows that among dippers' assistants the attack rate of females is more than three times as great as that of the males. "The number of miscarriages," according to the report, "among females who had worked in lead before marriage was found to be nearly three times as great as among artisan mothers, and four times as great as in lead workers after marriage."

The apparently greater susceptibility of young adults, as observed by some writers, is perhaps largely the effect of their naturally greater personal carelessness and ignorance.

CONTRIBUTORY CAUSES OF LEAD POISONING.

PERSONAL HABITS.

The habits of the individual worker play a by no means minor rôle in plumbism. Working under the best sanitary conditions it is possible for a slovenly man to ingest more lead than another who, although working under poor sanitary conditions, avails himself of the ordinary preventive measures. The fault is sometimes with the management, because of poor discipline and meager instruction regarding the lead hazard, and again it is with the individual, who either ignores the simple precautions or prides himself on his bravado. It is not infrequent to hear men openly boast of their fearlessness in exposing themselves to danger. They apparently delight to talk of the number of years they have worked in lead and of "what conditions used to be," and to offer themselves as examples of good health and as proofs that lead poisoning does not exist, at least in their plant. These statements are not substantiated by physical examinations, which on the contrary disclose many physical defects and even plumbism in some of these men. Such boasting intimidates the men who are inclined to protect themselves. Habits contributory to plumbism, as they were observed by our investigators, have been discussed under the previous headings and will be analyzed further in Section IV.

PHYSICAL CONDITION OF THE WORKER.

Anything that lowers resistance in the worker increases his chance of lead poisoning. Alcoholism, pulmonary tuberculosis, and syphilis, together with individual susceptibility, are conditions recognized as favorable to lead absorption and subsequent lead poisoning. Mouth breathing, wide atrophic nasal passageways, absence of nasal hairs, removed turbinates, and other defects encountered in individuals, are important physical factors. Near-sighted workers, for instance, may have to get closer to the source of dust, and so may be exposed to more dust than a fellow worker with normal vision.

LEAD POISONING AND IMPORTANCE OF DIAGNOSIS ON ACCEPTED SYMPTOMS.

LACK OF UNIFORMITY AMONG AUTHORITIES.

The reported prevalence of chronic lead poisoning among pottery workers has been for some time the subject of discussion in leading periodicals and medical journals, and has led to surveys of the potteries in a number of States. These surveys were conducted by different investigators, and a great dissimilarity of results is noted, due, in part, to the wide difference of opinions as to what constitutes a case of chronic lead poisoning.

NEED FOR EARLY DIAGNOSIS.

If industrial medicine is to progress at an equal rate with other branches of medicine, industrial physicians must diagnose cases of industrial poisoning promptly, that preventive measures may be adopted on the part of the employees in time to preclude inefficiency with resulting sickness and loss of time from work. The surgeon no longer waits for fecal vomiting before diagnosing intestinal obstruction, nor the internist for the tubercle bacillus to recognize the presence of tubercular processes. Neither must the industrial physician wait for basophilic degeneration, the lead line, or the presence of lead in the urine—symptoms which are frequently absent—before diagnosing lead poisoning. The failure to find basophilia is in many instances due to faulty technique or to the fact that the counterstain used obscures fine stippling. There is no great advantage in diagnosing lead poisoning after the development of arterio sclerosis and chronic nephritis. Frequently the more advanced signs of lead poisoning only tend to complicate the diagnosis and even lead to serious mistakes. Hayhurst (19) says, "Many times the abdominal symptoms are mistaken for constipation, ileus, hepatic colic, renal colic, vesical colic, tabetic crises, and appendicitis." It is not unusual to learn that operations have been performed in such cases.

As the mass of information accumulates there arises the necessity of standardizing the collection of data, in order to make a fair comparison, by conditions and occupations, of the existence of chronic lead poisoning. It is important that investigators in the field who are collecting these statistics should decide upon some group of symptoms and signs which will justify the diagnosis of incipient lead poisoning.

PRESENT-DAY STANDARDS.

A review of the literature of the subject indicates that so far no common basis for determining cases of chronic lead poisoning has been arrived at, and that the individual investigator uses his own standard. Dr. Alice Hamilton (20) very forcibly illustrates this fact in giving the views of two physicians, one of whom considers "anemia and lead line" as a mild case, while with the other nothing less than "a severe attack of colic, constipation, nausea, and vomiting, requiring medical care for two weeks," would be termed a mild case. Dr. Hamilton also emphasizes the fact that "the majority (21) of physicians hesitate to speak of lead poisoning, if there is no colic."

Linenthal (22) enumerates seven cases of undoubted plumbism, but diagnosed otherwise, taken from the records of the Massachusetts General Hospital—a fact which "illustrates the reluctance, even among good clinicians, to make a diagnosis of plumbism in the absence of the lead line, or stippling." He gives the following history of another case:

> For nearly five years this man had been presenting himself at various times at the hospital, complaining of a train of symptons which, taken together with his work, should have made a diagnosis possible, and yet he was permitted, during all this time, to continue to work without any precautions, until the lead line appeared, when the diagnosis of lead poisoning was made.

REASONS WHY EARLY DIAGNOSIS IS NOT MADE.

Such diversity of practice is not strange when leading clinical authorities do not agree among themselves. Some textbooks either do not treat the subject at all or treat it in such a manner as to lead the student to look for the so-called pathognomonic signs rather than to impress upon him the necessity of recognizing the early symptons.

Simon (23) considers the following the "essential factors": "Secondary chlorotic anemia, basophilic granular degeneration, variable hyperleukocytosis with normal differential count; general tendency to interstitial nephritis, with corresponding urinary changes." He further states:

> My own investigations, besides those of Grawitz, Block, White, and Pepper, and others, prove that even a comparatively trifling exposure to lead almost invariably leads to the appearance of stippled cells in the blood. Generally speaking, their number is proportionate to the degree of intoxication * * *. In rare instances they may be absent.

According to Stevens (24), the "chief manifestations" are—

> anemia with granular degeneration (basophilic) of the red cells; severe colicky pains centering around the umbilicus, with retraction and rigidity of the abdominal walls; constipation; a blue line on the gums near the insertion of the teeth, due to the deposition of a sulphuret of lead; paralysis; tremors; intense headache; pains in the joints (arthralgia); arteriosclerosis; chronic interstitial nephritis; and grave cerebral symptoms (encephalopathies).

Cabot (25) says:

> Lead poisoning from occupation is usually preceded by signs of lead colic. The patients are seized with paroxysms of severe cutting pains in the abdomen. An attack in its greatest intensity rarely lasts longer than a quarter of an hour, and after a shorter or longer interval, severe paroxysms of pain set in anew. The abdomen is retracted; there is constipation, and the pulse is slow.

After giving treatment for this condition, he adds:

> The first attack is succeeded by a second, a third, etc., and the serious tragedy of lead poisoning begins.

Post Graduate Medicine, by Augustus Caille (26), treats of lead colic, but not of lead poisoning. On the other hand, Osler (27), Anders and Boston (28), Wood and Fitz (29), give descriptions of chronic lead poisoning in its various stages. As a proof of the absence of basophilia, Oliver (30) states that in 70 per cent of his cases he failed to find basophilia. Nor does he consider the blue line in itself a proof of lead poisoning. "In many cases of undoubted plumbism it is absent altogether" (31).

DIFFERENCE IN TERMINOLOGY.

The confusion is increased by the difference in terminology used by various investigators to express different degrees of intoxication. Legge (32) gives as "classical symptons," lead colic, paresis, lead anemia or cachexia; as "earliest symptons," changes in the vascular system, wasting of the subcutaneous fat, pallor and drawn expression of the face; as "definite evidence that absorption is leading on to poisoning," anemia, presence of basophile granules in a previously healthy person, and diminution in hemoglobin to 75 per cent; as "further proof," wasting of the muscles, mental lethargy, and loss of power over individual muscles or groups; and as "prominent," high blood pressure, colic, blue line, and paralysis. Again (33) in classifying cases he divides them into slight, moderate, and severe. In general the groups are as follows:

SLIGHT.

1. Colic without complications—of comparatively short duration.
2. Anemia, in adolescence aggravated by employment.
3. Either of the above, with tendency to weakness of extensors.

MODERATE.

1. A combination of colic with anemia.
2. Profound anemia.
3. Partial paralysis.
4. Cases in which there is constitutional debility.

SEVERE.

1. Marked paralysis.
2. Encephalopathic conditions, such as convulsions, optic neuritis, mental affections.
3. Grave undermining of the constitution, associated with paralysis, renal disease, and arterio-sclerosis.

The phrase "lead absorption," together with the attempt to show a symptomatology for it, has become confusing. Manufacturers' physicians use this term as much as possible instead of the term "lead poisoning," because lead poisoning must be reported. All toxic symptoms and signs due to lead come under the head of "lead poisoning;" and not, even when some of them only appear, under the head of "lead absorption."

Rambousek (34) regards the blue line, accompanied by an unpleasant sweetish taste, malaise, and weakness, and occasionally by tremor of the muscles, disinclination for food, and pains in the stomach, as a "premonitory indication"; colic as the "most important feature"; and peripheral motor paralysis of the extensors of the forearms, as the "predominant" feature of a case running a typical course.

Thompson (35) gives abdominal colic, paralysis of the hands and forearms, or "wrist drop," increased blood pressure, a lead line in the gums, constipation, anemia, and granular basophilia, as "striking symptoms"; and a fixed, drawn expression, light jaundice, lead in urine, sometimes alimentary dextrosuria, levulosuria, and hematoporphyrinuria, dyspepsia, increased tendon reflexes, vertigo, nausea, metallic taste, and finally emaciation, as "other symptoms."

Hamilton (36) cites the following case as a typical example of mild chronic lead poisoning:

> A girl of 19 years has worked three years in the dipping room of a white ware pottery, during which time she has had two attacks of colic. She is pale and has not much strength, partly, her mother thinks, because she eats so little. She is very apt to vomit in the morning if she takes breakfast, and can eat nothing at any meal till she has had a sour pickle to rid her mouth of the sweet taste. She is always constipated and takes cathartics regularly.

Dr. Hamilton calls attention to the digestive tract and the blood as producing the "first symptoms," pallor, loss of morning appetite with a sweetish taste; loss of strength, headaches, and pains in the limbs, and constipation.

Hayhurst (37) gives as "chief features" breakfast anorexia, extending later to all meals; metallic taste; nausea, with or without vomiting; loss of weight; loss of strength; constipation, perhaps alternating with diarrhea; pain in the lumbar region; pain in the joints; headache; drowsiness; insomnia; confusion; blind spells and dizziness. For chronic poisoning he emphasizes the following symptoms: Diseased condition of the gums—usually supplanting the lead line; atrophy, particularly of the most used set of muscles, with accompanying signs of tremors, weakness, muscular incoordination; decreased or absent muscular reflexes, and perhaps fibrillations; vascular hypertension, associated with arterio-sclerosis; cardiac weakness after only moderate exercise; chronic Bright's disease; "rheumatism" of chronic type, particularly of the ankles, feet, and back—a common complaint; weakness of hand grip; basophilic degeneration, which signifies acute intoxication of progressive character, is uniformly absent; so also is Liebermann's test, and lead in the urine. He further says:

> Lead poisoning actually exists when evidence of actual intoxication is added to a history of exposure, or is added to (*a*) the sign of absorption, i. e., the "lead line," or (*b*) the absolute sign of elimination, i. e., lead in the urine * * *. The chief constant and early physical sign of lead intoxication is pallor of the face including the lips, which is due more to arterial spasm than to anaemia. The chief symptoms are in somewhat descending order, digestive disturbances, insomnia, and weakness.

EARLY DIAGNOSIS.

Many authorities hesitate to state what symptoms or signs would justify an early diagnosis of lead poisoning. Oliver (38) says: "One of the earliest symptoms is colic," qualifying this statement at once by adding, "but for some time previous to the onset of abdominal pain it will be found on inquiry that the patient on getting up in the morning had experienced a disagreeable metallic taste in the mouth, which prevented his enjoying his breakfast—that he felt headachy and rather sick. His features, too, had been altering, for his face had been gradually becoming paler and more expressionless." It would appear from these observations that colic was a rather late symptom and that the symptoms and signs noticed "some time previous" should be recognized as the earliest symptoms.

Linenthal (39), who advocates the early diagnosis of lead poisoning, believes that "a history of exposure to lead justifies the diagnosis of lead poisoning in patients presenting obscure symptoms which can not otherwise be explained." He regards seriously "pallor of the skin, muscular weakness, rheumatic pains, loss of appetite, constipation, or constipation alternating with diarrhea, abdominal pains, general nervousness, and persistent headaches, when occurring in persons exposed to lead, for they may be the precursors to the more serious nerve lesions, such as wrist-drop, encephalopathy, and to the more insidious and less dramatic change in the vascular and excretory systems, that of arterio-sclerosis and chronic nephritis."

Chapman (40) states that "the lead line, wrist-drop, and colica pictonum, together with a history of occupational exposure, readily suggest lead, but the chronic form in which none of these symptoms occur, or at least occur in mild or obscure form, is probably very often overlooked."

"The symptoms," says Rambousek (41), "are very varied and associated with the most different groups of organs * * *. Numerous cases follow an irregular course, in that special symptoms or complications of symptoms are in some especially accentuated, while in others they become less marked or are absent altogether."

Thompson quotes Prof. M. Allen Starr (42) as asserting that "many cases of loss of vigor and so-called neurasthenia are actually due to chronic lead poisoning."

Sommerfeld and Fischer write (43):

> Industrial lead poisoning appears as a rule in the chronic form and arises from continuous absorption of the most infinitesimal quantities of lead during a protracted period of time (weeks, months, and even years).
>
> The beginning is insidious, with disturbance of the general health, a sense of weakness, decline of bodily strength; sallow, pale-yellowish hue of the skin; distress in the region of the stomach, eructations, lack of appetite, metallic taste in the mouth, and fetid breath.
>
> The blue line (blue-gray discoloration of the gums), which, however, may be absent, even in the course of a severe attack; lead colic with most obstinate constipation, retention of urine; plumbic arthralgia (lacerating, boring), occurring for the most part paroxysmally, chiefly in the lower extremities, more rarely in the upper, often interpreted as a symptom of rheumatism of the joints; frequently, fibrillar trembling of the fingers. Typical are the lead paralyses, of which disturbances of sensation (paresthesia and anesthesia) take the precedence. Paralysis generally affects the extensor muscles of the arm and hand, with atrophic manifestations; more rarely the flexor muscles. Sometimes also there are paralyses of the extensors and flexors of the lower extremities or muscles of the shoulder. From experience it is known that those groups of muscles are especially affected which are most used in the occupational activity. Transient blindness, but also gradually progressive atrophy of the optic nerve; temporary loss of the special senses of smell and taste; violent, often fatally ending disease of the brain (saturnine encephalopathy), sometimes preceded only by slight premonitory symptoms, as irritability and headache, ringing in the ears, insomnia; more often, slowly increasing mental disturbances precede; epileptiform convulsions, hallucinations; morbid changes in the blood vessels and of the heart and kidneys (contracted kidney); increase of blood pressure and granular degeneration of the red blood corpuscles. Disturbances in the sexual sphere in women; abortion, premature birth, low vitality of the children.

Rosenau (44) states:

> Symptoms of lead poisoning are sometimes vague and readily overlooked. The usual symptoms of chronic lead poisoning are anemia, dyspepsia, depression, constipation, colic; various forms of paralysis, especially paralysis of the extensor muscles of the forearm leading to wrist-drop; a blue line along the edges of the gums, due to the formation of sulphid of lead deposited in the tissues. Optic neuritis may come on. There is an increase in the blood pressure. Chronic lead poisoning leads to arteriosclerosis, fibrosis of the kidneys, and the remote consequence of these changes. Muscular paresis, pain and swelling of the joints, often occur and may be mistaken for "rheumatism."

G. L. Apfelbach (45), in his paper on the "Early Diagnosis of Lead Poisoning with Special Reference to Abdominal Pain," enumerates the following six findings as cardinal symptoms of lead poisoning—namely, constipation, pallor and anemia, colic, stippling, blue line, and tremor. He bases these findings on observations made as follows:

(1) On a series of 934 cases of lead poisoning received in reports from the Illinois Department of Factory Inspection between July 1, 1912, and July 1, 1917; (2) on a series of 72 cases in which he personally made the examinations. In the series of 934 cases constipation was found to be the most constant finding, occurring 335 times, followed next by colic and anemia. In the series of 72 cases constipation was found in 81.9 per cent of them; tremor in 72.2 per cent; pallor and anemia in 65.2 per cent; basophilic degeneration in 51.3 per cent; abdominal pains of varying types in 56.9 per cent, and blue line in 26 per cent.

These are the conclusions arrived at by Dr. Apfelbach:

(1) Manifestations of an intoxication with lead are variable, sometimes presenting one or two of the cardinal signs of this intoxication, which are: Colic, constipation, blue line, tremor, basophilic degeneration of the red cells, and pallor and anemia.

(2) Early diagnosis of plumbism can be established by the history of lead workers and by the presence of constipation plus one or more of the cardinals, fine tremor, blue line, basophilic degeneration of the red cells, colic, and pallor and anemia. Constipation, with pallor and anemia or with colic, presents a suspicious picture which must be developed by the aid of subsidiary findings.

(3) Anemia and fine tremor are very early signs of plumbism.

(4) Since more lead workers suffer from vague abdominal pains and gastric disturbances than from colic, a differential diagnosis of any abdominal pain or colic or gastric disturbances demands the consideration of lead as the possible cause.

(5) There does not seem to be a constant rise in blood pressure in acute or subacute cases of lead poisoning.

METHODS OF CLASSIFICATION AND DIAGNOSIS USED IN THIS SURVEY.

Cases were classified as follows:

1. Positive:
    - A. Acute.
    - B. Chronic.
2. Presumptive.
3. Suggestive.
4. Negative for lead poisoning.

Under the supervision of the officer in charge our field physicians held preliminary and periodical conferences in which the whole subject of lead poisoning was discussed in order that a more uniform diagnosis of degrees of plumbism might be made.

It was decided that only cases presenting symptoms and signs—such as a combination of marked pallor, colic, wrist-drop, lead line, basophilic degeneration, and other conditions—which are recognized as typical of lead poisoning and which almost preclude any doubt even among those inclined to refute the prevalence of lead poisoning, were to be considered as positive cases of plumbism. These cases would readily be diagnosed as plumbism by the general practitioner, even without the history of exposure. Whenever any combination of symptoms and signs could possibly be explained by a condition which the examiner could not, on account of limited facilities, rule out to his own satisfaction, or where some of the more prominent signs of lead poisoning were indefinite or not absolutely indicative of plumbism, so as to create a doubt in the mind of the examiner, the cases were considered presumptive, even though it might be safer perhaps to classify them as positive. In this group are cases that many clinicians would unhesitatingly diagnose as positive. These cases, if seen at a later period—the length of time depending upon length and degree of exposure—and if subjected to further observation and tests, would doubtless present unmistakable symptoms and signs of positive plumbism; but in a cross-section study of this kind where the subjects could not be placed under observation for a definite period of time, and where these employees might discontinue their employment and therefore never develop the more advanced signs, our investigators did not feel justified in classifying them as positive.

The suggestive group includes those who have certain common symptoms which might indicate a degree of lead poisoning. These are cases complaining of symptoms and presenting signs of a similar nature, such as metallic taste, constipation, morning anorexia, headaches, diminished hand grip, anemia, and other symptoms that could not be satisfactorily explained otherwise, but which are, however, common symptoms of many complaints.

TENTATIVE CLASSIFICATION FOR AN EARLY DIAGNOSIS OF LEAD POISONING.

It is not necessary to emphasize the various stages of lead poisoning and any line of demarcation between the degrees of intoxication must of necessity be arbitrary; but it is imperative that we accept some basis for this grouping. An early recognition is vital in preventive medicine in the industrial field. As actual poisoning exists before even the experienced eye can detect its manifestations, it is justifiable to recognize as suggestive of lead poisoning any group of symptoms of a similar nature noted in a number of workers exposed to the lead hazard, until the presence of such symptoms can be explained otherwise. It is obvious that not every complaint made by these workers should be attributed to lead absorption. Where a fairly representative number of workers exposed to lead complain of similar symptoms, which did not exist before they took up their present employment, or which have become aggravated since but which disappear with a change of work, the diagnosis of chronic lead poisoning is warranted, and a study of the conditions to determine or to disprove the presence of the lead hazard should be made.

For the purpose of analyzing records of industrial physicians, labor departments, and future surveys of lead hazards, for the purpose of making a comparison of the data and conclusions thus obtained, a standard terminology for characterizing stages or degrees of lead poisoning is suggested. This terminology might well follow that adopted in the present survey as outlined above.

The suggestive group of symptoms for each subdivision, as a basis for preparing all data, is outlined below. In presenting this outline emphasis is placed upon the necessity, in making a diagnosis therewith, of careful study of each individual case, with due consideration of any personal conditions which might influence the statements of the workers. Special attention is called to the importance of gathering complete preliminary information pertaining to—

1. A history of known or suspected exposure to lead in any form.
2. The personal history and physical examination of the worker, with a view to eliminating conditions which would possibly simulate symptoms of lead poisoning.

As an aid to a decision on the positiveness of lead poisoning it is recommended that a choice of any two or more symptoms, selecting one from each of the following groups, would, in conjunction with the numerous minor symptoms that are always present if these major symptoms are noted, be a reasonable basis for a diagnosis of positive lead poisoning. Should only one of these major symptoms appear, in combination with two or more symptoms of the presumptive group of the same general headings and also in conjunction with the minor symptoms that would be present, a diagnosis of chronic lead poisoning could also be made. Emphasis has been placed on the combination of the so-called major symptoms and the minor symptoms, because it is very unlikely that such major symptoms would ever be found alone in any case of lead poisoning. A combination of minor symptoms invariably accompanies more typical ones.

A. General appearance:
  Marked pallor and profound anæmia.
B. Digestive system:
  Colic.
  Obstinate constipation.
C. Muscular system:
  Muscular incoordination.
D. Nervous system:
  Peripheral motor paralysis of certain extensor muscles (wrist and ankle drop) and atrophy of most used set of muscles.
E. Vascular system:
  Blood—basophilic degeneration with diminished hemoglobin.
F. Special organs and findings:
  Gums—lead line.
  Stools and urine—lead.
  Miscarriage—repeated.
  Liebermann's test—positive.

In a like manner presumptive diagnosis would be suggested by the findings of any three or more symptoms selected singly from each of the following general headings. Here, also, a combination of minor symptoms assists a decision:

A. General appearance:
  Pallor.
  Anemia.
  Emaciation.
  Drawn expression.
B. Digestive system:
  Loss of appetite or repugnance to food.
  Breakfast anorexia.
  Vomiting on eating solid food.
  Sweetish or metallic taste.
  Gastric disturbances.
  Constipation.
  Pain in abdomen.
  Parotitis.
C. Muscular system:
  Loss of strength.
  Malaise and tiring easily.
D. Nervous system:
  Headache.
  Insomnia.
  Mental lethargy.
  Tremor.
  Dizziness.
  Convulsions.
  Mental affections.
  Encephalopathic conditions.
  Arteritis.

E. Vascular system:
    Arteriosclerosis.
    Hypertension.
F. Special organs and findings:
    1. Eyes—
        Impairment of vision, including muscular incoordination.
    2. Joints—
        Various pains.
    3. Blood—basophilic degeneration with diminished hemoglobin.

While it is true that in other industries as well as in potteries workers show on numerous occasions and under varying conditions symptoms which, when taken in conjunction with other symptoms, may be characteristic evidence of some degree of lead poisoning, yet such symptoms would be only suggestive of this particular poisoning. However, if his occupation exposes the worker to a lead hazard, and if any combination of the following symptoms appears among a number of workers so exposed, the association between such symptoms and such exposure would justify the industrial physician in suspecting lead as the causative agent in inducing these symptoms and would justify him in making a diagnosis of suggestive lead poisoning:

Constipation.
Loss of weight.
Loss of strength.
Drowsiness.
Pain in lumbar region.
Pain in joints.
Headache.
Insomnia.
Confusion.
Loss of morning appetite.
Metallic or sweetish taste.

Cases should be classified according to the above outline only after careful elimination of confusing conditions as shown in the history of the worker. Due emphasis must be given to the fact that although these workers are exposed to a lead hazard they are still equally susceptible to diseases and intoxications foreign to their occupation, and that certain of these produce symptoms identical with those of lead poisoning. For instance, a luetic person may complain of headache, joint pains, weariness, and may have arteriosclerosis with hypertension; or certain focal infections may give rise to symptoms simulating lead poisoning. Among women menstrual disorders or uterine displacement may cause constipation, headache, pain in abdomen, anemia, etc. Nor do these few examples illustrate all the conditions which are apt to confuse the diagnostician in deciding the presence or absence of lead poisoning, for other associated processes producing vapors, fumes, gases, and metallic dusts may lead to symptoms resembling those of lead. On the other hand, the facts that these conditions exist does not exclude the suspicion of lead poisoning. The question whether these are caused by the occupation or are concomitant with it must be answered by careful deliberation of the previous history of the individual and by the physical and laboratory findings.

While in the surveys just completed our investigators have been conservative in diagnosing lead poisoning, it is recommended to those who practice medicine where lead poisoning may arise that they make tentative diagnoses on the symptoms outlined under suggestive and presumptive lead poisoning, so that workers exposed to a lead hazard may be given the benefit of early treatment.

After the survey had been completed and careful tabulation of the diagnoses of these workers had been made and studied, it was found that the symptoms given and the diagnoses made conformed remarkably with the outline as given here for future diagnoses of lead poisoning.

Therefore we offer this classification and combination of symptoms and signs as an outline for future work in surveys of this nature.

CASES OF LEAD POISONING FOUND IN THE POTTERY SURVEY.

Notwithstanding the many corrective recommendations made by investigators in the past surveys, the incidence of lead poisoning in the potteries is still high. Managers, and employees as well, apparently believe that facts have been exaggerated and that the lead hazard is practically nil in the potteries. They maintain this belief even after the results of former surveys have been made public.

We have already discussed the symptoms upon which the diagnosis of lead poisoning have been made by leading diagnosticians, and we are now ready to give in tabular form the story of plumbism as we find it in the 92 potteries coming within the scope of our survey. The analysis of these figures, designed to show factors pertinent in causing lead poisoning, is reserved for Part IV of this report, where an attempt is made to show the rate of plumbism according to ware and to size of plant; according to plant hygiene, as it bears upon dustiness, personal facilities, toilet conditions; and according to the personal habits of the workers.

Table XX shows by classification the number of each sex examined, diagnosis by wares and States, and the totals for each.

TABLE XX.—*Distribution of pottery employees by State, ware, sex, and diagnosis.*

	New Jersey.			Ohio.					
	Sanitary.	General.	Total.	Sanitary.	General.	Yellow.	Art.	Tile.	Total.
Number of potteries	15	9	24	1	35	4	4	3	47
Number employed:									
Male	1,480	942	2,422	200	4,575	277	425	694	6,171
Female	79	401	480	0	2,299	71	250	248	2,868
Number exposed:									
Male	178	133	306	15	600	43	61	39	758
Female	11	29	40	0	205	8	20	10	243
Number examined:									
Male	173	125	298	15	571	41	61	38	726
Female	11	21	32	0	181	7	19	18	225
Positive:									
Male	9	7	16	1	52	1	3	0	57
Female	0	1	1	0	10	0	0	0	10
Presumptive:									
Male	9	11	20	0	37	2	3	1	43
Female	2	1	3	0	22	0	0	0	22
Suggestive:									
Male	13	5	18	0	69	4	3	0	76
Female	1	4	5	0	22	2	2	1	27
Negative:									
Male	142	102	244	14	413	24	52	37	550
Female	8	15	23	0	127	5	17	17	166

	Pennsylvania.				West Virginia.			All States.	
	Sanitary.	General.	Tile.	Total.	Sanitary.	General.	Total.	Total.	Total both sexes.
Number of potteries	2	5	1	8	3	10	13	92	....
Number employed:									
Male	780	635	38	1,453	352	2,160	2,512	12,558	17,297
Female	0	375	20	395	12	984	996	4,739	
Number exposed:									
Male	76	89	6	171	35	234	260	1,504	1,902
Female	0	37	1	38	2	95	97	398	
Number examined:									
Male	72	87	6	165	31	216	247	1,436	1,809
Female	0	29	1	39	0	86	86	373	
Positive:									
Male	9	10	1	20	1	32	33	126	139
Female	0	0	0	0	0	2	2	13	
Presumptive:									
Male	3	1	0	4	0	11	11	78	106
Female	0	0	0	0	0	3	3	28	
Suggestive:									
Male	5	4	0	9	1	25	26	129	168
Female	0	0	1	1	0	6	6	39	
Negative:									
Male	55	72	5	132	29	148	177	1,103	1,396
Female	0	29	0	29	0	75	75	293	

Attention is called to the fact that of the total of 1,809 persons examined as exposed to the lead hazard 139 cases of positive lead poisoning are found, of which 126 are men and 13 women. There are 106 cases classified as presumptive cases of lead poisoning, of which 78 are men and 28 women. There are 168 cases of suggestive lead poisoning, of which 129 are men and 39 are women. In all, 1,396 cases are found in which there is no evidence of lead poisoning; of these 1,103 are men and 293 women.

RATES OF PLUMBISM.

In obtaining rates where the line of demarcation between the various groups is not always sharply drawn there are several methods, some of which may be considered satisfactory, provided the method used is made clear and provided the attention of the reader is directed toward the method used at the several points in the discussion.

In many diseases there are so many different stages of progress that differ among different people and at different times and under varying conditions that there may be some doubt as to whether the so-called "border-line cases" should be excluded from consideration in getting rates, or included, and if included, whether they should be placed with those having a disease or ailment or with those not having such disease or ailment. We enumerate below the several methods by which rates may be obtained in the study of the development of plumbism among pottery workers.

If we consider only positive cases of lead poisoning as cases of plumbism, we get a rate of 8.8 per cent for the men, 3.5 per cent for the women, and 7.7 per cent for both, or a rate of 77 per thousand of those examined.

If we include both positive and presumptive cases, we get a rate of plumbism of 14.2 for the men, 11 for the women, and 13.5 for both, or a rate of 135 per thousand.

If we include both positive cases and presumptive cases, and either exclude the suggestive cases or divide them as an unknown group proportionately between the lead and the nonlead groups, we get rates of 15.6 for men, 12.3 for women, and 15 for both, or 150 per thousand.[1]

If we include all cases that are not negative—that is, positives, presumptives, and suggestives—we get rates of 23.1 for men, 21.5 for women, or 22.8 for both, which is a rate of 228 per thousand. This means that 76.8 per cent of the men and 78.5 per cent of the women, or 77.2 per cent of both, were not affected by lead poisoning at the time this survey was made.

In our analysis which follows under Part IV we include only positive cases of lead poisoning and get our rates by finding what per cent this number is of the total number examined, although we give occasionally rates for the other groups in addition to the positive groups. Our interests are not in getting high rates but in finding whether plumbism exists among pottery workers and in getting rates among age, exposure, occupational, and other groups in order to discover whether there are contributing factors which assist the lead used in the various glazes in causing higher rates of lead poisoning than would be found under other conditions.

We wish to call attention, however, to certain measurements typical of the different diagnostic groups which show the effects of lead poisoning. Among these are lengths of exposure, dynamometer readings, variation of systolic pressure, and variation of pulse pressure. The results are such as to lead us to the conclusion that the different diagnostic groups simply represent different degrees of plumbism. For all practical purposes—that is, for purposes of treatment and for an attempt to better the conditions among which the employees must work—there is such a slight difference between the positive and presumptive groups that they may well be considered together. However, we have tried to be conservative in this study, and for that reason give separate rates for these groups. Hence, in the report we speak of rates of positive lead poisoning and of rates of positive and presumptive lead poisoning, so that the reader will know exactly what group is included by such rates and combination of rates.

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[1] The rates used in our annual report for the fiscal year ending June 30, 1920, were obtained by this method.

PHYSICAL EXAMINATION WITH SPECIAL REFERENCE TO SOME IMPORTANT FINDINGS IN PLUMBISM.

Prominent symptoms found among the cases of lead poisoning in this survey compared in the following tables with those enumerated by Apfelbach (45).

	Number.	Per cent.
Prevalence of certain conditions among positive and presumptive cases of lead poisoning:		
Among the men, 201 cases—		
Lead line	120	59.7
Constipation	105	52.2
Colic	68	33.8
Pallor	101	50.2
Coated tongue	84	41.8
Muscle weakness	15	7.5
Tremor	118	58.7
Loss of weight	19	9.5
Wrist-drop	24	11.9
Paralysis	2	1.0
Neuralgia	76	37.8
Rheumatism	109	54.2
Pulse below 65 (164 reported)	7	4.3
Pulse above 95 (164 reported)	22	13.4
Systolic pressure of 15 or over more than Life Extension Institute Standard (196 reported)	65	32.6
Systolic pressure of 15 and over less than Life Extension Institute Standard (196 reported)	20	10.2
Pulse pressure 55 or over	92	45.8
Pulse pressure under 30	4	2.0
Headache	88	43.8
Arteriosclerosis	40	19.9
Among the women, 41 cases—		
Lead line	15	36.6
Constipation	28	68.3
Colic	15	36.6
Pallor	11	26.8
Coated tongue	8	19.5
Muscle weakness	2	4.9
Tremor	10	24.4
Loss of weight	7	17.1
Wrist-drop	2	4.9
Paralysis	1	2.4
Neuralgia	19	46.3
Rheumatism	18	43.9
Pulse below 65 (38 reported)	0	0.0
Pulse above 95 (38 reported)	6	15.8
Pulse pressure 55 or over	12	29.3
Systolic pressure of 15 or over more than Life Extension Institute Standard	8	19.5
Systolic pressure of 15 and over less than Life Extension Institute Standard	3	7.3
Pulse pressure under 30	1	2.4
Headache	29	70.7
Arteriosclerosis	6	14.6

	Number.	Per cent.
Out of 934 cases of lead poisoning Apfelbach enumerates the findings in the number of times reported:		
Blue line	518	55.4
Anemia	341	36.5
Constipation	335	35.87
Colic	295	31.58
Pallor	244	25.48
Coated tongue	215	21.3
Loss of muscular strength	161	17.3
Tremor	135	14.45
Abdominal tenderness	131	14.0
Slow pulse	130	14.0
Nausea	113	12.1
High-tension pulse	74	7.9
Headache	74	7.9
Loss of weight	50	5.3
Albuminuria	27	2.88
Dyspepsia	26	2.8
Wrist-drop	24	2.37
Abdominal pain	18	1.9
Other paralysis	10	1.0
Vertigo	11	1.0
In a critical examination of 72 cases of lead poisoning the following symptoms and signs occurred the following number of times (Apfelbach):		
Constipation	59	81.9
Stippling	37	51.3
Blue line	26	36.1
Fine tongue tremor	39	54.1
Fine tongue tremor	13	18.1
Anemia and pallor	25	34.7
Pallor	8	11.1
Anemia	14	19.4
Colic	23	31.9
Abdominal pain	18	25.0
Neuritis	12	18.0
Diminished strength in hand	7	10.0
Loss of muscular strength	7	10.0
Sciatica	1	1.4
Albuminuria	2	2.8
Convulsions	1	1.4
Cerebral hemorrhage	1	1.4
High blood pressure	1	1.4
Coated tongue	[1]	......

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[1] Uncertain.

It is significant to note, after a comparative study of the tables, that no one symptom is constantly present. It seems apparent, also, that certain symptoms are exaggerated by habits of the individual and frequently may be due to such habits; for instance, the tremor in men in all probability is influenced by smoking, chewing, and drinking. In comparing the rate of men with that of females the age factor, the average of which is higher in men, must be considered. In women the high percentage of headaches is probably due to other causes, such as menstrual disorders, etc.

It must be remembered, furthermore, that the data found in textbooks on cases of lead poisoning have been collected from well-advanced or acute cases which have presented themselves to the clinics, whereas the cases recorded in this survey are largely early cases which have not necessitated a visit to a physician. This fact may account for our inability to verify the high arterial blood pressure emphasized by some observers. Further reference to this high pressure and a comparison with other trades will be found in this report.

BLOOD PRESSURE.

Methods and averages among pottery employees.—The blood pressures were taken of 1,411 men and 358 women workers in the lead department of the pottery industry. While these blood-pressure readings were taken by several different physicians, the general method in each case was the same. In taking the systolic and the diastolic reading the ausculatory method was used, the patient sitting; and it was the universal practice to read as the systolic pressure the first reappearance of the sound, and as the diastolic the complete disappearance.

Table XXI gives, by sexes and by age groups, the systolic and diastolic pressures and the pulse pressures of the pottery workers examined in this survey. The average systolic pressure for the men is 135.87, the average diastolic pressure is 81.3, with an average pulse pressure of 56.5, when these averages are taken by grouping the measures in class intervals of 10 for the systolic and diastolic pressures and 5 for pulse pressure. The average systolic pressure for women is 123.8, the average diastolic pressure is 74.6, and the average pulse pressure is 49.21.

TABLE XXI.—*Blood pressure of all pottery workers.*

Age.	Systolic.										
	90-99	100-100	110-119	120-129	130-139	140-149	150-159	160-169	170-179	180-189	190 plus.
MEN.											
Under 20...	4	8	22	31	26	10	5	1	1	....	....
20-24.......	....	4	18	31	28	11	5	4	....	....	....
25-29.......	3	4	26	46	39	22	8	3	3	1	....
30-34.......	1	2	32	48	58	28	6	4	5	2	....
35-39.......	1	8	43	46	72	28	12	5	....	....	1
40-44.......	1	15	31	55	50	36	9	8	2	2	1
45-49.......	1	8	10	30	34	22	23	7	2	....	3
50-54.......	....	2	13	22	24	26	11	10	7	3	8
55-59.......	....	3	7	9	14	16	11	13	8	6	4
60 plus.....	....	....	4	7	6	9	14	11	8	8	11
Total.	11	54	206	325	351	208	104	66	36	22	28
WOMEN.											
Under 20...	3	28	37	34	2	4	2	....	....	....	....
20-24.......	....	12	23	28	5	....	....	....	....	....	....
25-29.......	....	7	15	21	9	....	....	....	....	....	....
30-34.......	....	5	11	17	2	....	....	....	....	....	....
35-39.......	1	2	7	5	4	3	....	1	....	....	....
40-44.......	....	3	7	5	3	1	2	1	....	....	....
45-49.......	....	1	2	11	8	4	2	1	1	....	2
50-54.......	....	....	1	2	5	3	2	....	....	1	....
55-59.......	....	....	....	1	2	2	1	1	....	....	1
60 plus.....	....	....	1	1	....	....	....	....	1	1	....
Total.	4	58	104	125	40	19	9	4	2	2	3

Age.	Diastolic.									
	Under 50.	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	130 plus.
MEN.										
Under 20............	3	11	26	32	23	9	4	....	....	....
20-24................	....	3	22	29	28	12	5	1	1	....
25-29................	2	7	33	60	37	13	1	2	....	....
30-34................	1	10	22	65	54	27	5	1	....	1
35-39................	1	8	20	63	85	28	9	2	....	....
40-44................	....	7	22	66	67	31	10	7	....	....
45-49................	2	1	18	44	40	24	10	1	....	....
50-54................	....	3	9	32	43	23	11	4	....	1
55-59................	....	2	9	16	27	19	13	4	1	....
60 plus..............	....	....	8	10	21	19	11	6	2	1
Total.........	9	52	189	417	425	205	79	28	4	3
WOMEN.										
Under 20............	1	17	29	48	10	4	....	1	....	....
20-24................	....	3	27	28	10	....	....	....	....	....
25-29................	....	2	17	24	9	....	....	....	....	....
30-34................	....	1	12	20	3	1	....	....	....	....
35-39................	....	2	5	9	4	2	1	....	....	....
40-44................	....	2	3	10	6	....	....	1	....	....
45-49................	....	....	6	11	10	2	....	2	....	1
50-54................	1	....	1	6	5	1	....	....	....	....
55-59................	....	....	....	2	1	3	1	....	....	1
60 plus..............	....	....	1	....	1	1	....	1	....	....
Total.........	2	27	101	158	59	14	2	5	....	2

TABLE XXI.—*Blood pressure of all pottery workers*—Continued.

Age.	Pulse.												
	Under 30.	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80 plus.	Total.
MEN.													
Under 20	3	8	10	11	14	21	13	12	3	2	3	8	108
20-24	6	5	9	11	16	16	6	15	6	4	2	5	101
25-29	2	......	14	13	28	27	14	19	13	8	4	13	155
30-34	6	9	13	26	24	24	28	18	7	10	8	13	186
35-39	13	9	22	32	31	35	21	15	11	13	5	9	216
40-44	9	11	17	35	30	44	16	16	10	13	6	3	210
45-49	......	8	6	14	14	26	22	18	11	6	6	9	140
50-54	1	4	6	13	10	21	17	20	7	3	4	20	126
55-59	2	4	3	6	13	7	7	10	7	6	4	22	91
60 plus	2	......	2	4	5	3	6	11	4	5	7	29	78
Total	44	58	102	165	185	224	150	154	79	70	49	131	1,411
WOMEN.													
Under 20	3	5	12	34	24	21	4	6	......	......	1		110
20-24	2	......	5	18	19	11	7	4	2	......	......	......	68
25-29	......	3	2	9	14	10	13	......	......	......	1	......	52
30-34	......	......	7	5	11	9	1	4	......	......	......	......	37
35-39	......	1	3	4	8	1	1	3	2	......	......	......	23
40-44	......	2	3	5	3	1	3	......	2	2	......	1	22
45-49	......	......	......	8	4	6	3	3	2	4	......	2	32
50-54	......	......	......	......	2	5	1	2	2	......	1	1	14
55-59	......	......	......	2	2	1	1	......	......	2	......	......	8
60 plus	1	......	......	......	......	1	1	......	......	......	......	1	4
Total	6	11	32	85	87	66	35	22	10	8	3	5	370

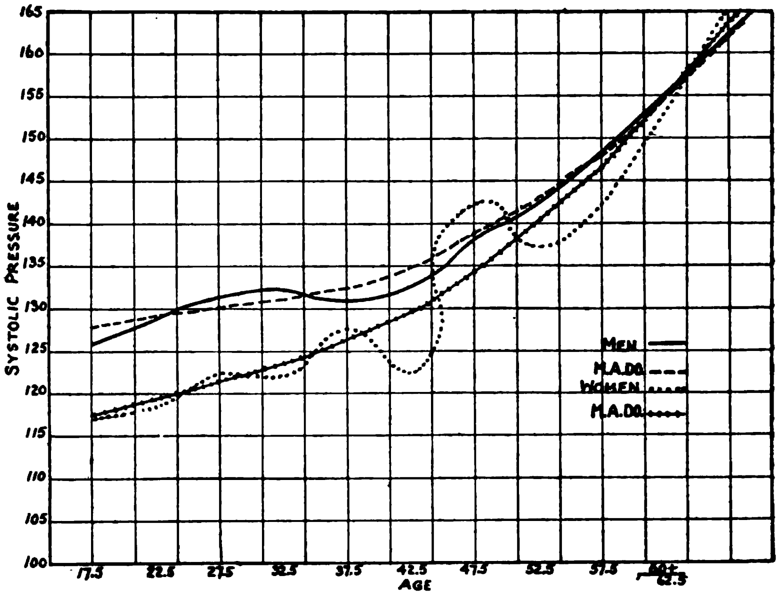

CHART 3.—Systolic pressure among 1,809 pottery workers and moving average for same.

Table XXII and the accompanying graph show the systolic pressure by sexes and age groups and moving averages for same.

TABLE XXII.—*Systolic pressure among pottery workers and moving averages for same.*

Age (years).	Male.		Female.	
	Systol.	Moving average 3.	Systol.	Moving average 3.
17.5	126.8	129.1	117.9	118.9
22.5	130.5	129.9	118.3	119.9
27.5	131.2	130.9	122.6	122.9
32.5	132.9	131.7	122.0	123.9
37.5	131.0	132.4	127.7	127.2
42.5	132.0	134.5	127.4	130.8
47.5	137.6	138.4	140.3	135.6
52.5	144.5	144.3	137.3	141.1
57.5	149.3	149.5	142.5	147.4
60	159.8	152.9	165.0	151.1

In order to give an estimate of the number of systolic and pulse pressures that seem to be high and of those that seem to be low, we have adopted the standards made by the Life Extension Institute, which are shown in the following table:

TABLE XXIII.—*Normal blood pressure by age groups as given by different authorities.*

Age (years).	Authority.						
	Life Extension Institute.[1]	Fisher.[2]	Rogers.[2]	Faught.[3]	John Ferguson.[3]	George Oliver.[4]	H. P. Woley.[4]
	Millimeters.	*Millimeters.*	*Millimeters.*	*Millimeters.*	*Millimeters.*	*Millimeters.*	*Millimeters.*
15-20	120	120	120	....	125	112-125	123
21-25	123	122	....	....			
26-30	124	123	123	....			
31-35	124	124	....	....			127
36-40	127	126	126	....			
41-45	129	128	....	....	128	125-135	130
46-50	131	130	130	....	130		
51-55	132	132	....	....	132		132
56-60	135	134	134	....	134		
61-65	....	135	....	....	....	135-165	....
66 plus	....	136	....	....	....		....
Range	±15	±12	±14-±16	±17	....	....	±17

[1] By correspondence; number of cases, 50,000.
[2] Medical Insurance and Health Conservation, Vol. XXVII, pp. 316-320, 1917-18.
[3] Canada Lancet, Vol. LI, p. 157, 1917-18.
[4] Studies in Blood Pressure, p. 109, 1917-18; number of cases, 1,000.

The systolic pressures vary from 120 millimeters at 20 years of age to 135 millimeters at 60 years of age, with a possible variation of 15 millimeters in either direction. A pulse pressure, according to results obtained by the Institute from measuring 50,000 male applicants for life insurance, should be within the limits of 30 to 55 millimeters. For the purpose of reference we give also in Table XXIII the findings according to other sources of measures of systolic pressure by age and the amount of variation as well.

According to these figures about 26.3 per cent of the men in the potteries and 13.2 per cent of the women have a systolic pressure which may be considered high, while 6.9 per cent of the men and 4 per cent of the women have a systolic pressure much too low. Taking the normal range of pulse pressure between 30 and 35, we find that 633 of the men and 83 of the women examined have high pulse pressure, while 44 men and 6 women have low pulse pressure. Stated in rates, this means that 47.9, or almost one-half of the men, and 24 per cent, or almost one-fourth of the women, have pulse pressures outside these limits.

Table XXIV shows averages of the various blood pressures by wares, sexes, and age groups. There is, perhaps, little significance to be attached to the figures in this table, and they are included here for reference only.

The effect of plumbism upon the blood pressure.—Tables XXV, XXVI, XXVII, XXVIII show the blood pressure for the positive, presumptive, suggestive, and negative cases of plumbism, respectively, for both sexes and by age groups.

It should first be observed that the ages of these groups vary somewhat. The positive male group has an average of 44.3, the presumptive male group 40.8, the suggestive 41.1, and the negative 37.5. The corresponding ages for the women are 39.2, 31.6, 33.3, and 29.5 years, respectively. There appears also to be an excessive number of pulse pressures of 55 and above. In the male lead groups this amounts to a little over 45.8 per cent of those examined, while in the nonlead groups it amounts to about 43.7 per cent. For the combined male potters 34 per cent of those examined had pulse pressures of 55 and above, while 3 per cent had a pulse pressure below 30. As compared with the pulse pressure of 2,039 male garment workers (see Public Health Bulletin No. 71), we found only 10.5 per cent of those examined to have pulse pressures of 55 and above and 24.4 to have pulse pressures below 30. This department recently examined 1,285 steel workers in the Pittsburgh district, 17 per cent of whom had pulse pressures above 55 and 7 per cent below 30. The department also examined recently 905 chemical workers in New York City; 22.5 per cent of those examined had pulse pressures of 55 and above and 11 per cent pulse pressures below 30.

TABLE XXIV.—*Average systolic, diastolic, and pulse pressures of the pottery workers, by wares, sexes, and age groups.*

MEN.[1]

Age (years).	Sanitary.				General.				Others.			
	Number.	Systolic mean.	Diastolic mean.	Pulse mean.	Number.	Systolic mean.	Diastolic mean.	Pulse mean.	Number.	Systolic mean.	Diastolic mean.	Pulse mean.
Under 20	20	134.1	78.9	55.4	80	123.9	74.6	51.3	8	126.1	65.0	61.1
20-24	27	135.0	73.8	59.9	58	129.0	82.1	49.0	15	130.3	76.9	55.3
25-29	36	140.0	80.3	61.8	90	127.4	75.4	54.4	29	127.8	76.7	55.0
30-34	53	137.0	79.5	60.4	115	129.9	79.9	51.2	18	132.4	77.1	55.3
35-39	39	135.9	78.2	59.6	156	129.6	80.9	50.7	21	131.7	84.0	50.0
40-44	38	139.7	81.3	59.9	153	131.5	82.4	49.7	19	129.2	78.2	53.3
45-49	29	142.7	82.2	61.8	99	138.1	83.6	57.8	12	131.7	80.8	50.8
50-54	23	147.9	84.6	60.9	92	143.9	85.1	58.0	10	141.5	80.0	62.8
55-59	14	153.2	89.3	64.8	74	148.3	86.9	65.8	3	145.0	91.7	55.8
60 plus	4	181.3	95.0	86.8	64	161.7	90.4	75.0	10	169.0	92.3	76.7
Total and average	283	139.93	80.29	61.1	981	135.0	81.9	54.8	145	133.8	79.5	55.9

WOMEN.[2]

Age (years).	Sanitary.				General.				Others.			
	Number.	Systolic mean.	Diastolic mean.	Pulse mean.	Number.	Systolic mean.	Diastolic mean.	Pulse mean.	Number.	Systolic mean.	Diastolic mean.	Pulse mean.
Under 20	1	105.0	75.0	32.5	96	117.9	71.6	45.9	6	120.0	73.3	45.0
20-24	2	130.0	75.0	55.0	58	117.6	70.0	47.4	7	118.1	72.1	46.8
25-29	3	118.3	75.0	47.5	42	123.1	73.1	51.3	4	117.5	72.5	45.1
30-34	1	125.0	75.0	52.5	32	121.9	73.8	48.6	4	122.5	75.0	45.0
35-39	.....	....	......	......	18	126.7	70.6	48.0	4	132.5	82.5	52.5
40-44	1	135.0	75.0	67.5	15	121.0	72.3	50.0	5	125.0	79.0	45.5
45-49	.....	....	......	......	25	142.3	84.8	57.0	5	139.0	83.0	53.5
50-54	2	145.0	80.0	65.0	9	129.4	73.9	54.7	2	165.0	115.0	45.0
55-59	.....	....	......	......	7	142.5	84.1	57.3	1	145.0	75.0	72.5
60 plus	.....	....	......	......	3	163.3	111.3	55.0	1	175.0	115.0	57.5
Total and average	10	127.0	76.0	53.5	305	127.8	74.0	49.6	39	128.3	79.4	48.0

[1] Average age for men, 37.6 years.

[2] Average age for women, 32.6 years.

TABLE XXV.—*Blood-pressure frequencies for positive cases, by sexes and by age groups.*

Age (years).	Systolic.											Diastolic.									
	90	100	110	120	130	140	150	160	170	180	190 and over.	Under 50.	50	60	70	80	90	100	110	120	130 and over.
MEN.																					
Under 20	...	1	....	1	1	....	....	....	....	....	....	....	...	...	3	...	...	....	....	....	....
20-24	...	...	....	1	2	....	....	....	....	....	....	....	...	1	...	2	...	....	....	....	....
25-29	1	1	....	3	2	....	1	....	....	....	....	1	...	1	5	...	1	....	....	....	....
30-34	...	...	4	5	1	2	....	....	1	....	....	....	...	4	2	5	2	....	....	....	....
35-39	...	1	3	1	5	2	1	....	....	....	....	....	...	...	6	6	1	....	....	....	....
40-44	...	1	3	2	8	7	2	1	1	....	....	....	1	2	8	8	5	1	....	....	....
45-49	...	...	2	4	4	....	5	1	....	....	....	....	...	...	7	4	4	1	....	....	....
50-54	...	1	1	4	2	6	3	....	2	....	....	....	...	...	7	8	3	1	....	....	....
55-59	...	1	2	3	1	1	....	1	1	1	1	....	...	1	1	7	2	1	....	....	....
60 plus	...	....	2	1	....	....	1	....	1	1	5	....	...	2	1	1	3	....	3	....	1
Total	1	6	17	25	26	18	13	3	6	2	6	1	1	11	40	41	21	4	3	....	1
WOMEN.																					
Under 20	...	...	....	....	....	....	....	....	....	....	....	....	...	...	...	...	...	....	....	....	....
20-24	...	1	....	1	1	....	....	....	....	....	....	....	2	...	...	1	...	....	....	....	....
25-29	...	...	....	....	....	....	....	....	....	....	....	....	...	...	...	...	...	....	....	....	....
30-34	...	...	1	2	....	....	....	....	....	....	....	....	...	1	1	1	...	....	....	....	....
35-39	...	...	....	....	....	....	....	....	....	....	....	....	...	...	...	...	...	....	....	....	....
40-44	...	1	....	....	1	....	....	....	....	....	....	....	...	1	...	1	...	....	....	....	....
45-49	...	...	....	1	1	....	....	....	....	....	....	....	...	...	...	2	...	....	....	....	....
50-54	...	...	....	....	....	....	1	....	....	....	....	....	...	...	...	1	...	....	....	....	....
55-59	...	...	....	....	1	....	....	....	....	....	....	....	...	...	...	...	1	....	....	....	....
60 plus	...	...	....	....	....	....	....	....	....	1	....	....	...	...	...	1	...	....	....	....	....
Total	...	2	1	4	4	....	1	....	....	1	....	....	2	2	1	7	1	....	....	....	....

TABLE XXV.—*Blood-pressure frequencies for positive cases, by sexes and by age groups*—Continued.

Age (years).	Pulse.												Total.
	Under 30.	30	35	40	45	50	55	60	65	70	75	80 and over.	
MEN.													
Under 20		1				1	1						3
20-24				1		1				1			3
25-29	1				2	2		1	1			1	8
30-34		2	1	2	1	2	1	2		1	1		13
35-39			4		1	3	1	2		2			13
40-44			1	2	4	8	2	2	2	2	2		25
45-49		1	1	2	2	3	1	3		1	1	1	16
50-54		1	1	2	2	3	2	4	1		1	2	19
55-59		1	2	2			1	2			1	3	12
60 plus				2		1		1				7	11
Total	1	6	10	13	12	24	9	17	4	7	6	14	123
WOMEN.													
Under 20													
20-24				1			1		1				3
25-29													
30-34				1		2							3
35-39													
40-44			1		1								2
45-49				2									2
50-54									1				1
55-59				1									1
60 plus												1	1
Total			1	5	1	2	1		2			1	13

TABLE XXVI.—*Blood-pressure frequencies for presumptive cases, by sexes and by age groups.*

Age (years).	Systolic.											Diastolic.									
	90	100	110	120	130	140	150	160	170	180	190 plus.	Under 50.	50	60	70	80	90	100	110	120	130 plus.
MEN.																					
Under 20				2		1						1				2					
20-24					1									1							
25-29				2		1		1					1	2	1	1					
30-34			4	1	3	4							1	2	7	2					
35-39		2	4	3	4	1	1	1				1	3	1	5	6					
40-44		1	5	2	2	2		1					1	2	6	3		1			
45-49		1	1	2	2	2							1		3	4					
50-54				1	3		2				1				3	3			1		
55-59					2		1	2					1		2		2				
60 plus					1		1			1							2		1		
Total		4	14	13	18	12	5	5		1	1	2	8	8	27	21	4	1	2		
WOMEN.																					
Under 20		1	2	1										1	1	1	1				
20-24			2	1	1									2	1	1					
25-29			1	5	2									4	2	2					
30-34		2	1	1										1	3						
35-39	1			1									1			1					
40-44			1	1											1	1					
45-49											1								1		
50-54							1								1						
55-59					1		1									1		1			
60 plus																					
Total	1	3	7	10	4		2				1		1	8	9	7	1	1	1		

TABLE XXVI.—*Blood-pressure frequencies for presumptive cases, by sexes and by age groups*—Continued.

Age (years).	Pulse.												Total.
	Under 30.	30	35	40	45	50	55	60	65	70	75	80 plus.	
MEN.													
Under 20	......	......	......	2	......	......	......	......	......	......	......	1	3
20-24	......	......	......	......	......	......	......	......	1	......	......	......	1
25-29	......	......	......	......	......	1	......	......	1	......	......	3	5
30-34	......	......	......	1	2	2	1	3	1	1	......	1	12
35-39	1	1	......	1	1	3	2	2	2	1	1	1	16
40-44	......	1	3	1	......	2	2	2	......	......	2	......	13
45-49	......	......	......	1	1	2	4	......	......	......	......	......	8
50-54	......	......	......	......	2	1	......	1	......	......	1	2	7
55-59	......	......	......	......	......	......	2	1	......	......	1	1	5
60 plus	......	......	......	......	1	......	......	......	1	1	......	......	3
Total	1	2	3	6	7	11	11	9	6	3	5	9	73
WOMEN.													
Under 20	2	1	......	......	1	......	......	......	......	......	......	......	4
20-24	......	......	1	......	1	1	......	......	1	......	......	......	4
25-29	......	......	......	1	1	2	4	......	......	......	......	......	8
30-34	......	......	2	1	1	......	......	......	......	......	......	......	4
35-39	......	......	1	......	1	......	......	......	......	......	......	......	2
40-44	......	1	1	......	......	......	......	......	......	......	......	......	2
45-49	......	......	......	......	......	......	......	......	......	......	......	1	1
50-54	......	......	......	......	......	......	......	......	......	......	1	......	1
55-59	......	......	......	......	1	1	......	......	......	......	......	......	2
60 plus	......	......	......	......	......	......	......	......	......	......	......	......	......
Total	2	2	5	2	6	4	4	......	1	......	1	1	28

TABLE XXVII.—*Blood-pressure frequencies for suggestive cases, by sexes and by age groups.*

Age (years).	Systolic.											Diastolic.									
	90	100	110	120	130	140	150	160	170	180	190 plus.	Under 50.	50	60	70	80	90	100	110	120	130 plus.
MEN.																					
Under 20	1	1	1	....	1	....	....	....	....	....	....	....	1	1	...	2	....	....	....	....	....
20-24	...	1	....	4	4	....	....	....	....	....	....	....	...	2	3	3	1	....	....	....	....
25-29	...	1	....	1	4	2	1	....	1	....	....	1	...	2	2	2	2	1	....	....	....
30-34	...	....	4	3	3	1	1	....	....	....	....	....	2	1	3	5	1	....	....	....	....
35-39	...	2	3	4	8	8	....	1	....	....	1	....	...	2	5	10	4	1	....	....	....
40-44	...	2	6	4	4	5	2	....	....	....	1	....	...	2	8	10	1	1	2	....	....
45-49	...	....	2	3	6	3	4	2	....	....	....	....	...	2	7	3	7	1	....	....	....
50-54	...	....	3	3	1	2	1	....	....	....	1	....	...	1	5	2	2	1	....	....	....
55-59	...	1	....	1	1	3	2	1	2	....	....	....	...	...	3	1	5	2	....	....	....
60 plus	...	....	....	1	....	....	....	1	1	....	2	....	...	...	1	1	2	....	1	....	....
Total	1	8	19	24	32	19	11	5	4	....	5	1	3	13	37	39	25	7	3	....	....
WOMEN.																					
Under 20	1	3	2	1	....	....	....	....	....	....	....	....	2	3	2	...	....	....	....	....	....
20-24	...	2	3	2	....	....	....	....	....	....	....	....	...	5	2	...	....	....	....	....	....
25-29	...	2	2	2	....	....	....	....	....	....	....	....	1	3	2	...	....	....	....	....	....
30-34	...	....	....	1	....	1	....	....	....	....	....	....	...	...	1	...	1	....	....	....	....
35-39	...	1	....	....	....	1	....	....	....	....	....	....	...	1	...	...	1	....	....	....	....
40-44	...	....	....	1	1	....	1	....	....	....	....	....	...	1	1	1	....	....	....	....	....
45-49	...	....	....	2	1	3	1	....	....	....	1	....	...	...	3	3	1	....	....	....	1
50-54	...	....	....	....	1	....	....	....	....	....	....	....	...	...	1	...	....	....	....	....	....
55-59	...	....	....	....	....	1	....	....	....	....	....	....	...	...	...	...	1	....	....	....	....
60 plus	...	....	1	....	....	....	....	....	....	....	....	....	...	...	...	...	1	....	....	....	....
Total	1	8	8	9	3	6	2	....	....	....	1	....	3	13	12	4	5	....	....	....	1

TABLE XXVII.—*Blood-pressure frequencies for suggestive cases, by sexes and by age groups*—Continued.

Age (years).	Pulse.												Total.
	Under 30.	30	35	40	45	50	55	60	65	70	75	80 plus.	
MEN.													
Under 20		1			1	2							4
20-24			2	2	2			2	1				9
25-29			2	2			2			1	1	2	10
30-34	1		1	2	2		2	3		1			12
35-39	2	1	1	6	2	3	3	1		1		2	22
40-44	1	3	1	6	2	4	1	3	1	1	1		24
45-49			1	2	3	1	4	3	3		3		20
50-54			1	2	2	1	2	1	1			1	11
55-59	1				2	2	1	1	1	1		2	11
60 plus					1		1					3	5
Total	5	5	9	22	17	13	16	14	7	5	5	10	128
WOMEN.													
Under 20			1	2	2	1		1					7
20-24			1	2	2	1	1						7
25-29		1			2		3						6
30-34					2								2
35-39				1			1						2
40-44							2					1	3
45-49				2	1		1		1	2		1	8
50-54							1						1
55-59							1						1
60 plus	1												1
Total	1	1	2	7	9	2	10	1	1	2		2	38

TABLE XXVIII.—*Blood pressure of negative cases.*

Age (years).	Systolic.										
	90-99	100-109	110-119	120-129	130-139	140-149	150-159	160-169	170-179	180-189	190 plus.
MEN.											
Under 20	3	6	21	28	24	9	5	1	1		
20-24		3	18	26	21	11	5	4			
25-29	2	2	26	40	33	18	6	2	2	1	
30-34	1	2	20	39	51	21	5	4	4	2	
35-39	1	3	33	38	55	22	10	3			
40-44	1	11	17	47	36	22	5	6	1	2	
45-49	1	7	5	21	22	17	14	4	2		3
50-54		1	9	14	18	18	5	10	5	3	6
55-59		1	5	5	10	12	8	9	5	5	3
60 plus			2	5	5	9	12	10	6	4	6
Total	9	36	156	263	275	159	75	53	26	17	18
WOMEN.											
Under 20	2	24	33	32	2	4	2				
20-24		9	18	24	3						
25-29		5	12	14	7						
30-34		3	9	13	2	1					
35-39		1	7	4	4	2		1			
40-44		2	6	3	1	1	1	1			
45-49		1	2	8	6	1	1	1	1		
50-54			1	2	4	3				1	
55-59				1		1		1			1
60 plus				1					1		
Total	2	45	88	102	29	13	4	4	2	1	1

TABLE XXVIII.—*Blood pressure of negative cases*—Continued.

Age (years).	Diastolic.									
	Under 50.	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	130 plus.
MEN.										
Under 20	2	10	25	29	19	9	4	......	......	......
20-24	......	3	18	26	23	11	5	1	1	......
25-29	......	6	28	52	34	10	......	2	......	......
30-34	1	7	19	49	41	25	5	1	......	1
35-39	......	5	17	47	63	23	8	2	......	......
40-44	......	5	16	44	46	25	7	5	......	......
45-49	2	......	16	27	29	13	8	1	......	......
50-54	......	3	8	17	30	18	9	3	......	1
55-59	......	1	8	10	19	10	10	4	1	......
60 plus	......	......	6	8	19	12	11	1	2	......
Total	5	40	161	309	323	156	67	20	4	2
WOMEN.										
Under 20	1	15	25	45	9	3	......	1	......	......
20-24	......	1	20	25	8	......	......	......	......	......
25-29	......	1	10	20	7	......	......	......	......	......
30-34	......	1	10	15	2	......	......	......	......	......
35-39	......	1	4	9	3	1	1	......	......	......
40-44	......	2	1	8	3	......	......	1	......	......
45-49	......	......	6	8	5	1	......	1	......	......
50-54	1	......	1	4	4	1	......	......	......	......
55-59	......	......	......	2	......	1	......	......	......	1
60 plus	......	......	1	......	......	......	......	1	......	......
Total	2	21	78	136	41	7	1	4	......	1

Age (years).	Pulse.												
	Under 30.	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80 plus.	Total.
MEN.													
Under 20	3	6	10	9	13	18	12	12	3	2	3	7	98
20-24	6	5	7	8	14	15	6	13	4	3	2	5	88
25-29	1	......	12	11	26	24	12	18	11	7	3	7	132
30-34	5	7	11	21	19	20	24	10	6	7	7	12	149
35-39	10	7	17	25	27	26	15	10	9	9	4	6	165
40-44	8	7	12	26	24	30	11	9	7	10	1	3	148
45-49	......	7	4	9	8	20	13	12	8	5	2	8	96
50-54	1	3	4	9	4	16	13	14	5	3	2	15	89
55-59	1	3	1	4	11	5	3	6	6	5	2	16	63
60 plus	2	......	2	2	3	2	5	9	3	5	7	19	59
Total	37	45	80	124	149	176	114	113	62	56	33	98	1,087
WOMEN.													
Under 20	1	4	11	32	21	20	4	5	......	......	1	......	99
20-24	2	......	3	15	16	9	5	4	......	......	......	......	54
25-29	......	2	2	8	11	8	6	......	......	......	1	......	38
30-34	......	......	5	3	8	7	1	4	......	......	......	......	28
35-39	......	1	2	3	7	1	......	3	2	......	......	......	19
40-44	......	1	1	5	2	1	1	......	2	2	......	......	15
45-49	......	......	......	4	3	6	2	3	1	2	......	......	21
50-54	......	......	......	......	2	5	......	2	1	......	......	1	11
55-59	......	......	......	1	1	......	......	......	......	2	......	......	4
60 plus	......	......	......	......	......	1	1	......	......	......	......	......	2
Total	3	8	24	71	71	58	20	21	6	6	2	1	291

There seems also to be a greater number of high systolic pressures among the potters, especially among those having lead poisoning, and in the same groups there seems to be a correspondingly large number of low systolic pressures. Table XXIX gives the average systolic, diastolic, and pulse pressures, by diagnosis and sexes, of those in the pottery industry.

Figure 4 shows graphically what Table XXIX shows numerically.

Table XXX gives the systolic averages for the male pottery workers, for the male workers examined in the other industries mentioned above, and for 963 foundry men examined recently in the vicinity of New York city. In Table XXX also is found the coefficient of variability of the systolic pressure in these eight groups. It should be noted that the highest coefficient of variability occurs among the positive cases of plumbism, where a variability of 0.183 is found. In the male presumptive cases the variability is 0.143, for the male suggestive cases 0.151, and for the male negative cases 0.135. This latter coefficient is higher than that in any of the other industries mentioned, with the exception of the chemical works. A discussion of the age factor will be given later.

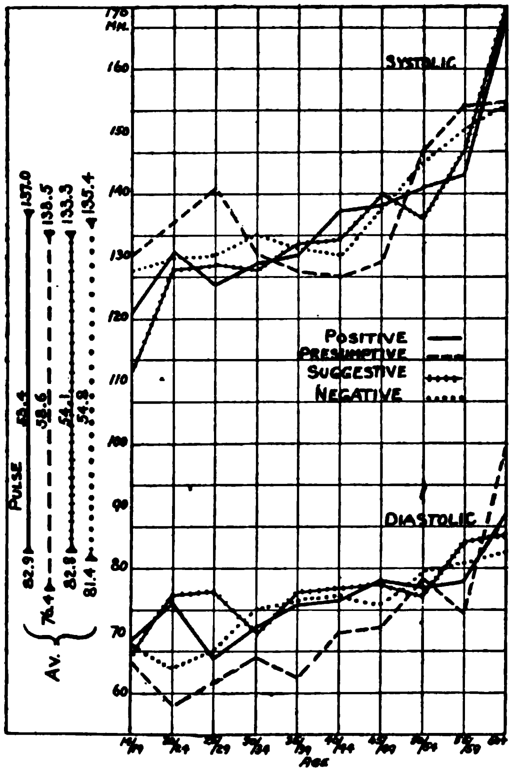

CHART 4.—Systolic and diastolic pressure, by diagnosis and age groups.

Table XXXI shows these same facts for the female workers in the pottery industry, and for 986 garment workers. Again this coefficient of variability is higher in the cases of lead poisoning and lower among the negative groups, and still lower among the garment workers. It is 0.171 for the positive group, 0.158 for the presumptive, 0.172 for the suggestive, 0.121 for the negative, and 0.081 for the garment workers.

These findings do not correspond exactly with those of clinical observers. Thus Norris (46) states that about 80 per cent of all lead workers exhibit for years a high arterial pressure, even when free from symptoms of poisoning. If, on the other hand, Nothnagel and Rossbach (47) are correct when they state that the chief action of lead is exerted on striated muscle, in which it produces a diminished ability to function, a hypotension would be the result, unless some compensatory action intervened.

TABLE XXIX.—*Number of cases and the average blood pressure for each age group, by sexes and diagnosis.*

MEN.

Age (years).	Positive.				Presumptive.				Suggestive.				Negative.			
	Number.	Systolic.	Diastolic.	Pulse.	Number.	Systolic.	Diastolic.	Pulse.	Number.	Systolic.	Diastolic.	Pulse.	Number.	Systolic.	Diastolic.	Pulse.
Under 20	3	121.7	75.0	47.5	3	131.7	71.7	59.2	4	112.5	72.5	46.3	99	127.4	74.8	53.0
20-24	3	131.7	78.3	55.8	1	135.0	65.0	67.5	9	127.2	78.3	49.7	87	130.7	70.9	52.3
25-29	8	125.0	72.5	55.6	5	141.0	69.0	75.0	10	129.0	79.0	59.5	132	130.7	76.6	54.5
30-34	13	129.6	77.3	51.7	12	130.8	73.3	59.4	12	128.5	76.7	51.7	149	133.6	80.4	54.2
35-39	13	130.4	81.2	52.5	16	128.0	69.1	57.2	22	131.7	83.2	50.5	165	131.0	81.9	51.0
40-44	25	137.8	81.8	56.3	13	127.3	76.5	52.9	24	132.1	83.7	49.3	148	131.3	82.5	50.2
45-49	16	138.1	84.4	55.3	8	128.8	77.5	53.1	20	140.0	84.0	58.5	96	137.8	81.3	56.3
50-54	19	140.8	83.9	57.9	7	147.9	85.0	64.6	11	135.9	82.3	54.3	88	145.6	85.9	59.1
55-59	12	142.5	85.4	58.3	5	151.0	79.0	68.0	11	147.8	90.5	59.3	64	150.8	87.7	61.9
60 plus	11	167.7	95.9	70.7	3	158.3	101.7	62.5	5	171.0	93.0	72.0	59	157.7	89.2	67.6
Total	123	138.4	82.9	56.6	73	134.3	76.4	59.1	128	135.5	82.8	53.9	1,087	135.4	81.4	54.8
WOMEN.																
Under 20	0	0	0	0	4	115.0	80.0	33.8	7	109.3	65.0	47.5	92	118.7	71.9	52.5
20-24	3	121.7	65.0	55.8	4	122.5	72.5	51.3	7	115.0	67.9	46.8	53	117.8	70.7	48.4
25-29	0	0	0	0	8	126.3	72.5	53.1	6	115.0	66.7	50.0	35	123.0	74.4	49.9
30-34	3	121.7	75.0	49.2	4	112.5	72.5	41.3	2	135.0	85.0	47.5	28	122.5	73.2	49.3
35-39	0	0	0	0	2	110.0	70.0	42.5	2	125.0	80.0	50.0	18	128.9	77.2	48.0
40-44	2	120.0	75.0	42.5	2	120.0	80.0	35.0	3	138.3	75.0	66.7	14	120.0	72.9	48.6
45-49	2	130.0	85.0	42.5	1	195.0	115.0	82.5	8	146.3	88.8	60.6	19	136.0	81.3	54.1
50-54	1	155.0	85.0	67.5	1	155.0	75.0	77.5	1	135.0	75.0	57.5	10	134.0	82.0	51.0
55-59	1	135.0	95.0	42.5	2	145.0	95.0	50.0	1	145.0	95.0	57.5	8	142.5	77.5	61.3
60 plus	1	185.0	85.0	90.0	0	0	0	0	1	115.0	95.0	27.5	2	175.0	125.0	62.5
Total	13	131.5	77.3	52.1	28	125.3	77.1	48.0	38	125.3	75.3	52.1	279	123.0	74.1	48.8

TABLE XXX.—*Systolic averages for pottery male groups and for male workers in other industries, by age groups.*

Age (years).	Positive.		Presumptive.		Suggestive.		Negative.		Garment.		Chemical.		Steel.		Foundry.	
	Number.	Average.	Number.	Average.	Number.	Average.	Number.	Average.	Number.	Average.	Number.	Average.	Number.	Average.	Number.	Average
Under 20	3	121.7	3	131.7	4	110.0	99	127.4	40	119.8	32	116.9	67	118.4	20	123.4
20-24	3	128.3	1	135.0	9	127.2	87	130.7	368	124.9	175	122.0	231	122.3	235	129.0
25-29	8	125.0	5	141.0	10	129.0	132	130.7	514	125.4	185	135.2	282	129.1		
30-34	13	128.1	12	130.8	12	128.5	149	133.6	432	124.9	180	125.0	238	132.3	382	128.9
35-39	13	130.4	16	125.0	22	131.7	165	133.8	293	128.0	150	126.1	208	131.7		
40-44	25	137.8	13	127.3	24	132.1	148	131.3	202	134.6	90	142.0	116	135.6	227	135.3
45-49	16	137.5	8	128.8	20	140.0	96	137.0	92	136.3	52	138.5	75	136.9		
50-54	19	140.8	7	147.9	11	135.9	88	145.6	56	138.9	22	133.2	36	137.1	84	134.8
55-59	12	141.7	5	151.0	11	147.8	64	150.8	28	142.8	10	154.0	26	138.5		
60 plus	11	168.6	3	158.3	5	171.0	59	151.3	14	147.1	8	153.8	6	141.7	15	143.5
Total and average	123	138.4	73	134.3	128	135.5	1,087	135.4	2,039	127.15	904	126.6	1,285	130.5	963	131.0
Coefficient of variability	...	.183	..	.143	...	.151	.....	.135	.....	.122	...	.141	.....	.133	...	.118
Age average	...	44.3	..	40.8	...	41.1	.....	37.9	.....	33.55	...	28.6	.....	32.6	...	36.8
Age coefficient of variability	...	.254	..	.257	...	.271	.....	.275	.....	.265	...	.353	.....	.290	...	.316

TABLE XXXI.—*Systolic averages for pottery female groups and for female garment workers, by age groups.*

Age (years).	Positive.		Presumptive.		Suggestive.		Negative.		Pottery.		Garment.	
	Number.	Average.	Number.	Average.	Number.	Average.	Number.	Average.	Number.	Average.	Number.	Average.
Under 20	....	....	4	115.0	7	109.3	92	118.7	103	117.9	225	112.6
20-24	3	121.7	4	122.5	7	115.0	53	117.8	67	118.0	516	113.9
25-29	....	....	8	126.3	6	115.0	35	123.0	49	122.5	167	118.3
30-34	3	121.7	4	112.5	2	135.0	28	122.5	37	122.0	35	117.9
35-39	....	....	2	110.0	2	125.0	18	128.9	22	127.7	23	130.7
40-44	2	120.0	2	120.0	3	138.3	14	120.0	21	122.6	13	125.0
45-49	2	130.0	1	195.0	8	146.8	19	136.0	30	140.3	4	137.5
50-54	1	155.0	1	155.0	1	135.0	10	134.0	13	137.3	1	155.0
55-59	1	135.0	2	145.0	1	145.0	8	142.5	12	142.5	1	155.0
60 plus	1	185.0	....	....	1	115.0	2	175.0	4	165.0	1	175.0
Total and average.	13	131.5	28	125.3	38	125.3	279	123.0	358	123.8	986	114.8
Coefficient of variability	....	.171	....	.158	....	.172	....	.121	....	.127	....	.081
Age average	....	39.2	....	31.6	....	33.3	....	28.5	....	29.3	....	23.4
Age coefficient of variability	....	.309	....	.359	....	.392	....	.418	....	.420	....	.232

According to the findings in this survey lead poisoning seems at first to increase the blood pressure materially, but after a time this high blood pressure may or may not be maintained.

The high percentage of cases of hypertension reported by clinicians may be attributed to the fact that the observations of the latter were for the most part made on well-advanced or acute cases which presented themselves to the clinics, whereas the cases recorded in this survey are largely early cases of lead poisoning and chronic cases which have not necessitated a visit to a physician.

Blood pressure according to length of exposure.—In an attempt to find the coefficient of variability of both the systolic pressure and the pulse pressure, according to length of exposure, it is found that the age variation differs so much according to length of exposure that it is hardly possible to get dependable results. For example, the coefficient of variability of the age of the males exposed less than one year is over twice as great as that of those exposed 10 years and more, while the coefficient of variability of the systolic pressure and of the pulse pressure remains somewhat constant. In order to eliminate the age group, it was decided to select a broad age period which would contain a large number of individuals, and so the following table was made from the pressures taken of all males between the ages of 25 and 39.

Variation in blood pressure among the male potters of the age group 25–39 according to length of exposure.

	0-0.9.	1-4.9.	5-9.9.	10 and over.
Average systolic pressure	126.6	133.6	133	132.4
Coefficient variability	.112	.117	.121	.121
Average pulse pressure	53.9	55.9	55	50.5
Coefficient variability	.228	.256	.318	.259

Reference to the above table shows that the coefficient of variability for the systolic pressure increases from 0.112 among those exposed less than one year to 0.121 among those exposed 10 years and over. While the coefficient of variability for the pulse pressure is not a regular series throughout this group, it varies from 0.228, for those exposed for less than one year to 0.259 for those exposed 10 years and over. Although these groups are still not of sufficient size to make these rates entirely reliable, yet they are the largest that can be obtained without making the age period too broad.

Table XXXII shows a summary of these and some other facts and conditions according to the diagnosis. While the coefficients mentioned show a greater amount of variation in systolic pressure among those workers in the pottery industry according to the degree of lead poisoning, there is also shown a greater variation among the same group in the measure of pulse pressure. The coefficient of variability for the positive male group in the measure of pulse pressures is 0.353; for the presumptive male potters, 0.301; for the suggestive male group, 0.311, and for the negative, 0.215. Among the females these coefficients range from the positive cases downward, 0.287, 0.241, 0.236, and 0.190.

TABLE XXXII.—*Summarizing some effects and conditions of plumbism.*

	Men.					Women.				
	Positive.	Presumptive.	Suggestive.	Negative.	Total	Positive.	Presumptive.	Suggestive.	Negative.	Total.
Number	126	78	129	1,103	1,436	13	28	39	293	373
Average age	44.3	40.8	41.1	37.5	38.8	39.2	31.6	33.3	38.5	29.3
Age coefficient of variability	.254	.257	.271	.275	....	.309	.359	.392	.418	....
Average systolic pressure	137.0	133.5	133.3	135.4	....	127.5	127.7	120.1	123.0	123.8
Systolic coefficient of variability	.183	.143	.151	.135	....	.171	.158	.172	.121	.127
Average pulse pressure	53.4	58.6	54.1	54.8	....	52.5	46.8	49.0	48.8	....
Pulse coefficient of variability	.353	.301	.311	.215	....	.283	.241	.236	.190	....
Average length of exposure (1 year)	17.0	15.7	14.0	9.8	11.1	9.9	6.3	5.9	4.0	4.6
Per cent under 1 year	3.4	5.2	3.8	16.5	....	0.0	14.3	10.3	43.8	....
Per cent under 5 years	16.0	15.6	15.3	34.8	....	15.4	62.8	61.5	75.4	....
Per cent under 10 years	26.6	27.3	35.1	50.0	....	53.6	75.0	87.2	87.4	....
Average pulse rate	82.3	82.7	81.3	81.5	81.6	87.7	83.9	85.8	84.8	84.9
Average grip:										
Right	39.1	39.7	41.7	41.9	41.6	23.8	25.0	24.0	25.9	25.9
Left	37.3	39.5	41.2	40.5	40.1	23.3	24.0	23.0	25.0	24.6

It might be argued that these greater variations among the lead cases is due to the greater variation in age. Table XXXII shows the coefficients of variations of the ages of these various groups; they are 0.254 for the positive, 0.257 for the presumptive, 0.271 for the suggestive, and 0.275 for the negatives. This is a gradually increasing series, showing a greater age variation in the negative group. In other words, the positive group with a higher systolic variation and with a higher pulse-pressure variation has the lowest age variation.

Likewise among the women the corresponding age coefficients of variability are 0.309, 0.359, 0.392, and 0.418—again a decreasing series as the intensity of lead poisoning increases, and again the positive group with the highest amount of variation in both measures of blood pressure has the lowest age variation. Table XXXII shows also the per cent of positive, presumptive, suggestive, and negative cases of both sexes according to the length of exposure.

Pulse rate of pottery workers.—The following table shows the frequency of pulse rate of pottery workers by sexes and by occupations.

TABLE XXXIII.—*Pulse rate of 1,077 men and 324 women workers in the potteries, by occupations.*

MEN.

All potteries pulse rate.	Foreman.	Glaze mixer.	Dipper.	Dipper's helper.	Ware carrier.	Ware cleaner.	Glost-kiln placer.	Kiln fireman.	Kiln drawer.	Oddman.	Sagger washer.	Decorator.	Total.
130			1				1						2
120-129	1	1	1				3			1			7
110-119			1				4						5
100-109		1	7	3	1		24			5	3		44
90-99	5	8	25	6	7	1	49			10	6	1	118
80-89	14	27	73	12	21	1	194	4		24	16	4	390
70-79	9	34	67	12	20	3	204	3	2	17	17	11	399
60-69	5	3	28	3	3		53			7	6		108
50-59	1						3						4
40-49													0
Total	35	74	203	36	52	5	535	7	2	64	48	16	1,077
Average pulse rate	83.86	80.14	81.45	83.33	82.90	81.00	81.39	80.71	75.00	83.91	81.46	78.75	0

WOMEN.

All potteries pulse rate.	Foreman.	Glaze mixer.	Dipper.	Dipper's helper.	Ware carrier.	Ware cleaner.	Glost-kiln placer.	Kiln fireman.	Kiln drawer.	Oddman.	Sagger washer.	Decorator.	Total.
130													0
120-129				1									1
110-119	1				2	4							7
100-109				8	2				1			1	12
90-99	2		2	29	15	19			1			1	69
80-89	5		1	52	23	37			1			2	121
70-79	2		4	47	25	25			1			4	108
66-69				3		2			1				6
50-59													0
40-49													0
Total	10	0	7	140	67	87	0	0	5	0	0	8	324
Average pulse rate	88.00	0	82.14	84.64	85.00	85.23	0	0	85.00	0	0	83.75	0

Table XXXIII gives a summary of pulse rates by occupations and sexes of those examined in this survey. The average pulse rate for men is 81.6 beats per minute. For women the average is slightly higher—84.9. These averages vary among the different occupations, although perhaps little significance should be attached to these differences. The highest average for the men appears to be among the foremen, of whom 35 have an average pulse rate of 83.86 per minute. The lowest average for the men is among the kiln drawers, of whom two have an average rate of 75; but the number of these latter is not sufficient to make this a reliable rate for this occupation.

The highest rate for women appears to be among the forewomen, where the average is 88. The lowest rate is among the dippers, 7 female dippers having an average rate of 81.4 beats per minute.

Table XXXV shows the range for men and women according to kind of ware manufactured, the median, the quartile deviations, modes, means, the average deviations, the standard deviations, and the coefficient of variability for the frequencies shown in Table XXXIII. There is perhaps little of significance to point out here, except that the range for men varies from 55 beats per minute to 135, while that for women varies from 65 to 125. The average rate for men, 81.6, is somewhat higher than might be expected for an average of 1,077 men. The average for women, 84.94, is perhaps also somewhat higher than might be expected for 324 women.

Figure 5 shows the frequency curve for the men and for the women, the horizontal axis of the curves representing the number of beats in each and the vertical axis the frequency of these beats in class intervals of 10. This is reduced to the basis of 1,000 workers for each sex. It should be observed that the frequency curve for the women is slightly to the right of that for the men, which indicates that the pulse rate for women is slightly higher than that for the men.

The effect of plumbism upon pulse rate.—For comparison according to diagnosis Table XXXIV shows pulse frequency rate for pottery workers and for garment workers, by sexes, and for the men employed in the chemical and in the steel industries. It should be noted that the average pulse rate for the men in the pottery industry, which is 81.6, is somewhat higher than that for the garment workers, 77.7, and that for the steel workers, 79.8; and slightly lower than that for the chemical workers, which is 82.5. The pulse rate of the male potters by diagnosis varies not more than 1.4 beats per minute—which fact is perhaps insignificant. The pulse rate for the female potters, 84.9, is also higher than that of the female garment workers, which is 80.6. Among the potters the greatest variation according to diagnosis is about 4 beats per minute, the highest being among the positive cases, and the lowest among the 27 presumptive cases. The small number of cases makes this average rather unreliable, and there is perhaps nothing of significance attached to these differences. The average deviations given vary somewhat according to diagnosis. This coefficient is 0.121 for the positive male cases and 0.100 for the negative male cases. Although the variation in pulse beat is much higher among the positive male cases, as shown by the differences in these coefficients of variability, the rates for the male presumptives and for the male suggestives do not warrant us in making a positive statement that pulse rate varies directly according to diagnosis. In fact, the coefficient of variability for the male garment workers is 0.128, which is higher than that for the positive lead group. A study of the coefficient of variability for the women workers fails to reveal any direct evidence that plumbism produces any greater variation in the pulse rate among the women.

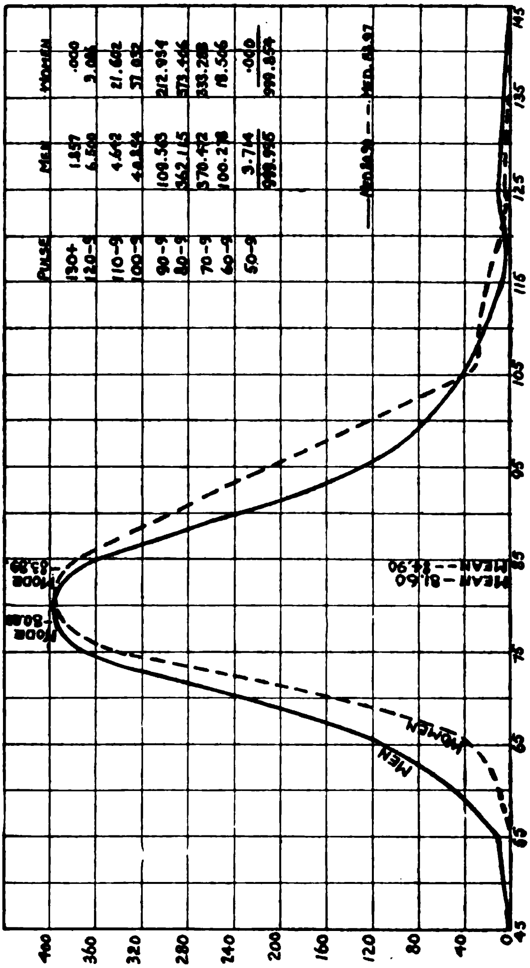

CHART 5.—Pulse rate of pottery workers.

Chart 6 shows the frequency curve of the male workers in the pottery, garment, chemical, and steel industries, reduced to the basis of 1,000 workers for each industry. These groups show the facts represented in Table XXXIV.

Table XXXIV.—*Pulse rate of potters and of workers in other industries, by diagnosis.*

MEN.

Pulse rate.	Positive.	Presumptive.	Suggestive.	Negative.	Garment.	Chemical.	Steel.	Potters.
130+				2	2	1	3	2
120-129	1		1	5	6	6	8	7
110-119	1		2	2	20	14	6	5
100-109	7	3	6	28	71	59	41	44
90-99	17	8	7	86	231	108	99	118
80-89	33	22	34	301	487	339	411	390
70-79	32	19	44	304	686	244	528	399
60-69	18	4	12	74	469	122	158	108
50-59				4	68	11	21	4
40-49					8		2	0
30-39					2			0
Total	109	56	106	806	2,050	904	1,277	1,077
Average	82.3	82.7	81.3	81.5	77.7	82.5	79.8	81.6
Coefficient of variability	.121	.094	.111	.100	.128	.115	.107	.103

WOMEN.

Pulse rate.	Positive.	Presumptive.	Suggestive.	Negative.	Garment.	Chemical.	Steel.	Potters.
130+					4			
120-129				1	2			1
110-119				7	6			7
100-109		2	2	8	33			12
90-99	6	4	5	54	80			69
80-89	2	10	12	97	274			121
70-79	3	11	7	87	488			108
60-69				6	75			6
50-59					2			
40-49								
Total	11	27	26	260	964			324
Average	87.7	83.9	85.8	84.8	80.6			84.9
Coefficient of variability	.90	.086	.077	.089	.097			.087

Table XXXV.—*The range, median, quartile deviation, mode, mean, average deviation, standard deviation, and coefficient of variability of the pulse rate of potters.*

MEN.

Potteries.	Pulse rate.								Number reported.
	Range.	Median.	Quartile deviation.	Mode.	Mean.	Average deviation.	Standard deviation.	Coefficient of variability.	
Sanitary	65-105	82.50	7.47	84.00	81.15	8.34	9.94	0.122	109
General	55-135	80.76	6.93	80.00	81.82	8.62	11.19	.137	837
Others	65-105	79.03	6.07	79.00	80.95	6.78	9.68	.119	131
All	55-135	80.70	6.84	80.00	81.60	6.37	10.79	.131	1,077

WOMEN.

Potteries.	Range.	Median.	Quartile deviation.	Mode.	Mean.	Average deviation.	Standard deviation.	Coefficient of variability.	Number reported.
General	65-125	84.41	7.06	84.10	85.35	7.34	10.24	0.120	286
Others	75- 95	84.75	5.94	80.00	81.84	7.21	7.99	.098	38
All	65-125	83.97	7.11	83.89	84.94	7.35	10.10	.119	324

The hand grip.—Before determining the effects of lead poisoning on the hand grip, we give here tables which show the correlation of right and left hand dynamometer readings, in kilograms, for the total 1,295 male and 342 female potters, and these readings are compared with readings for workers in some other trades.

TABLE XXXVI.—*Correlation of right and left hand dynamometer readings, in kilograms, for 1,295 male potters.*

Left hand.	Right hand.											
	Under 20.	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-65	65-69	Total.
65-69										1		1
60-64								1	1	2	1	5
55-59						4		9	13	8	1	35
50-54	1				2	4	17	35	17	2	2	80
45-49			3	1	9	38	95	40	10			196
40-44	2		1	7	55	137	75	23	5	1		306
35-39		1	4	24	219	110	21	7	2			388
30-34		2	14	70	69	16	3	1				175
25-29	2	5	30	22	13	6	1	2				81
20-24	3	1	13	3	1	1						22
Under 20		2	1		1		2					6
Total	8	11	66	127	369	316	214	118	48	14	4	1,295

Average: Left hand—40.1 kilograms; right hand—41.6 kilograms.

TABLE XXXVII.—*Correlation of right and left hand dynamometer readings, in kilograms, for 342 female potters.*

Left hand.	Right hand.								
	Under 15.	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total.
40-44								2	2
35-39				1	3	2	1		7
30-34			2	9	15	6			32
25-29		3	22	72	25	2			124
20-24	1	12	51	49	3	1			117
15-19	2	27	10	6	1				46
Under 15	8	3	2	1					14
Total	11	45	87	138	47	11	1	2	342

Average: Left hand—24.6; right hand—25.6.

Among male potters the readings for the right hand range from between 60 and 65 kilos to less than 20 kilos, with an average of 41.6 kilos. The readings are from top to bottom for the right hand, and from left to right for the left hand. It is seen that 8 of these 1,295 male potters had grips of less than 20 kilos for the left hand, and 4 had grips of between 65 and 69.

Of the 342 women examined, 2 had grips of from 45 to 49 kilos for the left hand, and 14 had grips of less than 15 kilos. For the right hand, 7 had grips of from 35 to 39 kilos, and 11 of less than 15 kilos. The average for the 342 women was 25.6 kilos for the right hand, and 24.6 for the left.

It is interesting to compare these rates with those found in other trades. Among 3,000 garment workers Schereschewsky found the following rates: Among 2,000 males, an average of 33.6 kilos for the right hand and 31 kilos for the left; among 1,000 females, 16 kilos for the right hand, and 13 for the left. The garment workers are, as a whole, a younger group than the pottery workers, and their trade does not tend to develop the muscles of the hands.

In the examination of 1,285 workers in steel and 903 workers in the chemical industry the average found for the right-hand grip of the steel workers is 42.9 kilos, and for the left 40 kilos; for the chemical workers, 41.4 and 39.3 kilos, for the right and left hands, respectively. Both these groups are slightly younger than the pottery workers.

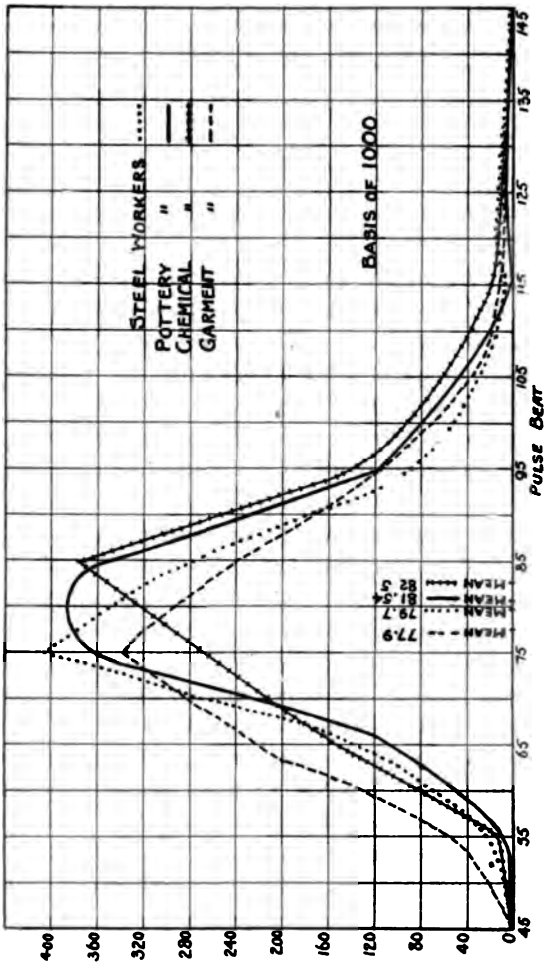

CHART 6.—Frequency of pulse beat among 1,000 men each of four industries. See table.

The effect of plumbism as shown by the dynamometer tests—

Tables XXXVI and XXXVII show the right and the left hand dynamometer readings for 1,295 male and 340 female workers in the lead department of the pottery industry. Table XXXVIII below shows these grip measurements by diagnosis:

TABLE XXXVIII.—*Grip measurement by sexes according to diagnosis.*

MALE.

Grip.	Positive.		Presumptive.		Suggestive.		Negative.		All.	
	Number.	Kilograms.	Number.	Kilograms.	Number.	Kilograms.	Number.	Kilograms.	Number.	Kilograms.
Right	117	39.1	67	39.7	122	41.7	989	41.9	1,295	41.6
Left	117	37.3	67	39.5	122	41.2	989	40.5	1,295	40.1
FEMALE.										
Right	12	23.8	26	25.0	36	24.0	268	25.9	342	25.6
Left	12	23.3	26	24.0	36	23.0	268	25.0	342	24.6

This table shows that as the intensity of lead poisoning increases there is a direct decrease of the muscular power of the hand as shown by the dynamometer readings. The male positive group has a right-hand grip measurement of 39.1 kilograms, the presumptive group measures 39.7 kilograms, the suggestive group 41.7 kilograms, and the negative group 41.9 kilograms. Likewise the left-hand grip for the male groups increases from 37.3 kilograms in the positive group to 40.5 kilograms in the negative. The female right-hand grip increases from 23.8 kilograms in the positive group to 25.9 kilograms in the negative, and the left-hand grip from 23.3 to 25. With minor exceptions these readings are consistent and point toward the fact that as the intensity of lead poisoning increases the individual gradually loses muscular power—especially that included in these measurements—provided that there are no other influencing factors at work in some of these groups and not in others.

In order to ascertain whether age is a factor influencing the tendencies shown in Table XXXVIII with respect to dynamometer measurements, approximately 1,000 male negative cases are tabulated in order to find the average dynamometer readings of both right and left hand of various age groups. Results are shown in Table XXXIX:

TABLE XXXIX.—*Dynamometer readings, in kilograms, by age groups for 993 negative cases.*

	Under 20.	20-24	25-29	30-39	40-49	50-59	60 plus.	Average.
Right	38.0	47.0	44.9	43.1	41.6	38.4	32.9	41.6
Left	35.0	44.2	43.2	42.3	39.3	38.5	32.6	39.9

The above table shows that the dynamometer readings increase up to the 25th year from 38 kilograms for the right hand and 35 kilograms for the left to 47 kilograms for the right and 44.2 kilograms for the left, and gradually decrease in each successive age period until those over 60 have a right-hand dynamometer reading of 32.9 kilograms and a left-hand dynamometer reading of 32.6 kilograms.

The rates given in Table XXXVIII for the right and left hand readings of the positive, presumptive, suggestive, and negative groups are adjusted for age grouping to the rates shown in Table XXXIX. The expected dynamometer readings according to age for these various groups and the actual average dynamometer readings for the male groups for both right and left hands are shown in Table XL:

TABLE XL.—*Average expected age dynamometer readings and actual readings according to diagnosis.*

	Positive.	Presumptive.	Suggestive.	Negative.
Right expected	41.8	41.7	41.7	41.8
Right actual	39.1	39.7	41.7	41.9
Left expected	39.8	41.0	41.0	40.6
Left actual	37.3	39.5	41.2	40.5

Table XL shows that only a small portion of the drop in dynamometer reading as we proceed from the negative group toward the positive group can be accounted for by the age of these various groups. In the suggestive group the actual right-hand dynamometer reading is that expected for a group distributed as these suggestive cases are among the various age groups. In the presumptive male groups the actual right-hand dynamometer reading is about two points below the rate expected, and in the positive group it is also about two points below the rate expected, from the distribution of these positive males among the various age groups. In the suggestive group the average left-hand dynamometer reading is about the same as the expected reading. In the presumptive group, however, the actual reading is about one and one-half points below, while in the positive groups it is two and one-half points below, the expected reading. This would indicate that only a small part of the drop in the dynamometer reading as the intensity of lead poisoning increases can be charged to difference in age.

An attempt is made to discover whether occupational differences may partly cause the differences shown in Table XXXVIII. A rather broad age group is selected, where the differences in dynamometer readings are at a minimum. Over 500 negative male cases in this age group give the following averages by occupation:

	Glaze mixer.	Dipper.	Dipper's helper.	Ware carrier.	Glost-kiln. placer.	Oddman.	Sagger washer.	Others.
Right hand	46.2	44.8	41.9	39.8	46.0	38.2	32.5	39.4
Left hand	43.0	42.3	39.9	39.5	45.0	39.1	30.7	37.2

These rates are taken in adjusting the dynamometer readings of the various diagnostic groups for occupational differences. The readings expected for these groups, from their distribution among the occupations, are as follows:

	Positive.	Presumptive.	Suggestive.	Negative.
Right hand	43.9	44.1	44.2	43.6
Left hand	42.4	42.7	42.8	42.3

Since there is no drop in these readings as we proceed from the negative group toward the positive, but rather a small rise, we conclude that occupational distribution does not account for the differences shown in Table XXXVIII.

By using the broad age group mentioned above we get the following average dynamometer readings by heights:

	Height (inches).							
	Under 64.	64-65.	66.	67.	68.	69.	70-71.	72 and over.
Right hand	38.3	42.7	43.3	43.7	42.1	43.8	46.4	45.4
Left hand	36.5	40.0	43.2	41.8	41.5	42.5	45.6	43.0

We are not able to find that differences in height affect the rates in Table XXXVIII in any manner. We therefore conclude that the decrease in dynamometer readings is caused by intensity of lead poisoning.

OTHER PHYSICAL DEFECTS NOTED IN THE EXAMINATION OF POTTERY WORKERS.

While it is not intended in this survey to enumerate the physical defects of pottery workers unless they have some possible bearing upon the results of plumbism, yet some defects occur so frequently that it may be well to note them.

Of the 1,436 men examined, 437 were found to have defective vision, 438 diseased gums, 446 defective teeth, 103 defective hearing, 78 diseased tonsils, while 367 suffered with headache, and 2 with epilepsy. Of the 373 women examined, 99 had defective vision, 48 defective gums, 147 defective teeth, 32 defective hearing, 77 defective tonsils, while 143 suffered with headache. One hundred six men and 64 women were found to be mentally depressed.

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PART IV.

CAUSATIVE FACTORS IN PLUMBISM.

It is the purpose in this chapter to analyze the results shown in Table XX, where we get a view in cross section of conditions with respect to plumbism as they existed in the 92 potteries at the time of this survey. It will be shown how the cases of lead poisoning are distributed among the various occupations of the potter, among the various types of ware manufactured by the pottery establishments, among the various plants with respect to the amount of soluble lead used in their glazes, and also among the plants themselves according to the number of employees. It is purposed, also, to show what factors in the manufacture of pottery goods seem to foster plumbism. An attempt is made to discover what relation, if any, exists between cases of lead poisoning and personal hygiene; also to determine whether a correlation exists between lead poisoning and plant hygiene and sanitation. In other words, this part of the investigation is an attempt to discover what effect certain plant conditions and what effect the personal hygiene of the workers may have in producing lead poisoning.

An attempt is made to adjust results in each case according to the effect of the age and sex distribution of the workers and according to the length and intensity of exposure to the lead hazard.

PERSONAL FACTORS.

It should perhaps be noted here that in every ill-effect upon the health of the individual there are exciting causes and contributory causes. In plumbism the exciting cause is lead. The contributory causes are perhaps personal conditions and habits, on the one hand, and plant processes and conditions of sanitation on the other. Personal conditions will first be discussed, such as age, sex, race, and length of exposure, over which the plant owner has little or no control, unless he should choose to hire a select group of factory workers. Later plant conditions and processes, factors for which the plant owner may be considered to be responsible, will be discussed.

AGE.

As age is an inherent factor in every investigation of the health of individuals, first will be shown rates of plumbism according to the different age groups. The five-year groups in which the rates of plumbism are practically constant are taken together in making up

Table XLI. This table shows rates of plumbism for different age groups by sexes.

TABLE XLI.—*Plumbism for different age groups, by sexes.*

MEN.

Age (years).	Positive.	Presumptive.	Suggestive.	Negative.	Total.	Rate of plumbism.	
						Positive.	Positive and presumptive
Average age	44.4	40.7	41.5	37.7	38.8	....	....
Under 20	2	3	4	99	108	1.9	4.6
20–24	4	1	8	94	107	3.7	4.7
25–39	34	35	43	453	565	6.0	12.2
40	86	39	74	457	656	13.1	19.1
Total	126	78	129	1,103	1,436	8.8	14.2

WOMEN.

Age (years).	Positive.	Presumptive.	Suggestive.	Negative.	Total.	Positive.	Positive and presumptive
Average age	39.8	31.4	32.4	28.2	29.3	....	....
Under 20	0	4	7	99	110	0.0	3.6
20–29	3	12	13	93	121	2.5	12.4
30–39	3	6	5	48	62	4.8	14.5
40	7	6	14	53	80	8.8	16.3
Total	13	28	39	293	373	3.5	11.0

Reference to the preceding table shows us that there is a gradual increase in rates as age increases. The rate for cases of positive plumbism for the male workers under 20 years of age is 1.9 or 19 per thousand; for the group 20-24 years of age it is 3.7; for the group 25–39 years of age it is 6; and for those 40 years old and over it is 13.1. Female workers under 20 years have a rate of 0.0; those between 20 and 29 years have a rate of 2.5; those between 29 and 39 a rate of 4.8; while those 40 years old and over have a rate of 8.8. It is perhaps sufficient to note at this point that this increase in the rate of lead poisoning with the increase of age holds true for workers of both sexes. A discussion of sex differences and of the relation of age to the length of exposure follows.

SEX.

Table XLII shows the rate of plumbism, the average age, and the average length of exposure by sexes.

TABLE XLII.—*Plumbism, by sexes.*

Sex.	Number.	Average age (years).	Average years exposed.	Average years exposed.		Number of plants.	Rate of positive plumbism in 65 plants.	Rate of positive plumbism in 92 plants.
				Positive.	Presumptive.			
Male	1,436	38.8	11.1	17.0	15.7	92	9.4	8.8
Female	373	29.3	4.6	9.9	6.3	65	3.5	3.5
Total	1,809	36.9	9.8	16.3	14.2	92	8.2	7.7

The rate of positive plumbism for all males examined is 8.8, and for all females is 3.5. In considering these rates it will be well to note the difference in ages of these two groups, the average age of the male being 38.9, and of the female 29.2. While we have not yet discussed the length of exposure to the lead hazard, the average length of exposure of the males is 11.1 years, and of the females is 4.6.

There are 27 plants in which no women are employed in the departments handling lead glaze. The 388 men employed in these 27 plants have a rate of positive plumbism of 7. An analysis of the age groups of the men employed in these 27 plants shows us that they are slightly underaged to such an extent that an expected rate of 8.1 would result. It is found also that they have been exposed for approximately one year less than the average time for all male workers. In the remaining 65 plants in which both men and women are employed the rate of positive plumbism among the men is 9.4, as compared with the rate 3.5 for the women in these same plants. In using this higher rate it should be remembered that the men are slightly older and have been exposed somewhat longer than those in the 27 plants employing no women. However, when a full analysis is made, considering all the contributing factors which come under our notice, including, of course, those of plant hygiene, we find that it makes little difference whether the comparisons are made among the 92 plants or among the 65 employing both men and women.

The average length of exposure of the positive male group is found to be 17 years and that of the female group 9.9 years. The average length of exposure of the male presumptive group is 15.7 and of the female is 6.3. In connection with this length of exposure it should also be mentioned that in most plants the length of day for the female worker is from one-half hour to one hour shorter than that of the male worker. It would seem that the female reaches these stages of lead poisoning in about half the time required for the male to reach them.

EMPLOYMENT.

Although we have not yet discussed rates of plumbism for the different occupations, it is thought best at this point to compare rates of lead poisoning in at least two occupations in which representative numbers of both men and women are employed. The specific work in these occupations may differ according to sex, yet both are employed in the same rooms and under the same conditions, and without doubt are exposed to about the same intensity. For example, 58 male ware carriers have no positive cases of plumbism, while 62 women ware carriers have a rate of positive plumbism of 4.8. In analyzing these two groups we find that the women are slightly older than the men. Thirty-two of the men are under 20, while only 25 of the women are of a like age. The women have been exposed for a slightly longer period of time. In adjusting these two factors we find that the men have an expected age rate of 5.5 and an expected exposure rate of 4.5, but with an actual positive rate of 0.0; while the women have an expected age rate of 3.3, an expected exposure rate of 3.1, and yet an actual rate of 4.8. Thus the men have a rate materially less than would be expected with respect to the two factors mentioned, while the women have a rate somewhat higher than would be expected.

There are also 71 male dippers' helpers and 149 female dippers' helpers employed in the same room at approximately the same kind of work and under somewhat similar conditions. The men are again slightly underaged and underexposed. One-half of the male dippers' helpers and one-third of the female dippers' helpers are under 20. The expected age and exposure rates correspond closely to the actual positive rate of 5.6 per cent for male dippers' helpers. The women have an expected age rate and an expected exposure rate, which in each case is about one-half of the actual positive rate of 4 for the female dippers' helpers. If we consider the positive and the presumptive cases together, the male dippers' helpers have a rate of plumbism of 8.4 and the women of 13.4.

With the exception of these two groups there are no others with sufficient numbers of both sexes to make a comparison reliable. Our analysis, however, indicates that when conditions of age, length of exposure, and occupation, with its attending conditions, are equal, the rate of plumbism is much higher among women than among men.

As shown by Table IV, over 80 per cent of the pottery workers are native born. It is, therefore, to be suspected that nationality does not play a large part in determining rates of plumbism either by age or by sex. A discussion of rates according to nationality is therefore left until we have made a study of the effect of length of exposure and of rates for the various occupations.

LENGTH OF EXPOSURE.

Table XLIII shows rate of plumbism for different lengths of exposure and lengths of exposure for the different diagnoses, by sexes. After due analysis it is found that the rates are about constant through each period as used in the table.

TABLE XLIII.—*Rate of plumbism for different lengths of exposure.*

MEN.

Years of exposure.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
					Positive.	Positive and presumptive.
0-0.9	2	6	4	172	1.1	4.3
1-4.9	14	10	12	214	5.6	9.6
5-9.9	15	11	26	180	6.5	11.2
10 plus	88	51	87	433	13.4	21.1
Total	119	78	129	999	8.9	14.9
Average years of exposure	17.0	15.7	14.0	9.8	....	11.1

WOMEN.

Years of exposure.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
					Positive.	Positive and presumptive.
0-0.9	1	5	4	95	1.0	5.7
1-4.9	3	8	18	113	2.1	8.0
5-9.9	4	7	11	40	6.4	17.8
10 plus	5	8	6	42	8.2	21.3
Total	13	28	39	290	3.5	11.1
Average years of exposure	9.9	6.3	5.9	4.0	....	4.6

It will be observed that the rate of plumbism increases with the years of exposure. The rate of positive plumbism for those males employed in exposed occupations for less than one year amounts to 1.1 per cent. For those employed for more than one year but less than five years the rate is 5.6 per cent. For those employed more than five but less than 10 years the rate is 6.5. For those employed for more than 10 years the rate is 13.4. The corresponding rates for the women workers are 1.0, 2.1, 6.4, and 8.2. This statement is emphasized by the fact that the average length of exposure of the male positive group is 17 years, the presumptive 15.7 years, the suggestive 14 years, and the negative 9.8 years, while the women workers have been exposed 9.9, 6.3, 5.9, and 4 years, respectively.

While the worker is getting more years of exposure, he is also adding more years to his age. For this reason it is sometimes argued that length of exposure and age mean about the same thing, and that consideration of one to the exclusion of the other would be sufficient. This might be true if all workers entered the glaze department of the pottery industry at a given age. On the contrary, when we undertake to analyze the age distribution for each of these exposure periods we find all ages represented. Workers of either sex enter the trade when over 60 years of age. A fairly large number begin work in the lead department when over 40 years of age. While the age of 40 and above is somewhat exceptional, there are sufficient numbers entering in that age group to make age analysis necessary. Table XLIV shows the rates of plumbism for these various periods of exposure adjusted for the age distributions represented by the employees coming under each of these groups.

TABLE XLIV.—*Rates of plumbism according to years of exposure, by sexes, adjusted for age distribution.*

	Years of exposure.				Total.
	0–0.9	1–4.9	5–9.9	10+	
MEN.					
Actual rate	1.1	5.6	6.5	13.4	8.8
Expected rate	6.0	7.2	8.0	10 6	8.8
Adjusted rate	1.6	6.8	7.2	11.1	8.8
Average age	28.4	33.3	35.8	44.5	38.8
WOMEN.					
Actual rate	1.0	2.1	6.4	8.2	3.5
Expected rate	2.9	3.1	4.1	4.4	3.5
Adjusted rate	1.2	2.3	5.5	6.5	3.5
Average age	26.8	28.2	31.4	37.8	29.3

It should be noted that when length of exposure for the male group is adjusted for age we have a rate of positive plumbism of 1.6 for the group exposed under one year, of 6.8 for those exposed more than one but less than five years, of 7.2 for the group exposed more than five years and less than 10, and 11.1 for the group exposed more than 10 years. The corresponding rates for the female workers according to exposure are 1.2, 2.3, 5.5, and 6.5. These rates include, of course, all occupations, and for that reason are hardly comparable between sexes. The rates for the different occupations will be taken up in the next section, and along with this will be discussed the intensity of exposure to which both sexes are subjected.

OCCUPATION.

In our discussion of exposure we said that it is related, as far as length of exposure is concerned, to age of the worker on the one hand, and suggested that, as far as the intensity of exposure is concerned, it may be related to occupation on the other. We have in our early sections discussed at some length the various processes and the various occupational duties of the workers and have shown in a variety of ways that those engaged in these different occupations are exposed to different phases of the glazing process. We have shown the differences in the amounts of dust and the varying amounts of lead in the dust in the various workrooms in which these processes are carried on and in which these employees of the different occupations must work. It is therefore expected that a measure of the amount of plumbism according to occupation will include, in a large measure, the element of intensity of exposure. Table XLV shows the number of cases of plumbism according to the diagnosis of our physicians among the various occupations in the pottery industry. It also shows the reduction to rates of the actual number of cases of plumbism in each occupation by sexes and by diagnosis.

TABLE XLV.—*Plumbism by occupation, sex, and diagnosis.*

Occupation.	Number.				Rate.			
	Positive.	Presumptive.	Suggestive.	Negative.	Positive.	Presumptive.	Suggestive.	Negative.
MEN.								
Foreman	2	3	3	31	5.1	7.7	7.7	79.5
Glaze mixer	11	10	10	81	9.8	8.9	8.9	72.3
Dipper	46	17	30	174	17.2	6.4	11.2	65.2
Dipper's helper	4	2	6	59	5.6	2.8	8.4	83.1
Ware carrier	......	1	1	56	......	1.7	1.7	96.6
Ware cleaner	......	......	......	9	......	......	......	100.0
Glost-kiln placer	49	39	71	548	6.9	5.5	10.0	77.5
Kiln fireman	2	......	1	9	16.7	......	8.3	75.0
Kiln drawer	......	1	......	5	......	16.7	......	83.3
Oddman	7	3	4	55	10.1	4.3	5.8	79.7
Sagger washer	3	2	3	65	4.7	2.7	4.7	89.0
Decorator	2	......	......	11	15.4	......	......	84.6
Total	126	78	129	1,103	8.8	5.4	8.9	76.8
WOMEN.								
Forewoman	......	1	......	9	......	10.0	......	90.0
Dipper	......	1	3	21	......	4.0	12.0	84.0
Dipper's helper	6	14	18	111	4.0	9.4	12.1	74.5
Ware gatherer	3	4	7	48	4.8	6.4	11.2	77.4
Ware cleaner	3	4	9	79	3.1	4.2	9.5	84.2
Kiln drawer	......	1	2	10	......	7.7	15.4	77.0
Decorator	1	3	......	15	5.3	15.8	......	78.9
Total	13	28	39	293	3.5	7.5	10.5	78.5
Grand total	139	106	168	1,396	7.1	5.8	9.3	77.2

A survey of this table shows that the highest rate of positive plumbism among the men is among the dippers. This rate is 17.2 per cent, or at the rate of 172 persons per thousand of the dippers examined in this survey. The next highest rates, where the groups are of reliable size, are among the oddmen and among the glaze mixers, where 10.1 per cent and 9.8 per cent, respectively, of those examined are found to have positive lead poisoning. Among the women the highest rate is found among the decorators, although the number examined is perhaps too small to make this a reliable rate. Moreover, we attempted in this survey to examine only those decorators who came in contact with the lead used in the pottery glaze. The limited number of decorators examined is therefore only a small part of all the decorators. As stated previously in our report, the lead hazard in the decorating department is a rather uncertain element, because in a great many instances lead is not used, while in others it is used with oils and in such ways that ground laying in lead and tinting with lead are not practiced to any great extent. Among the ware gatherers, however, we have a rate of 4.8 per cent out of a total of 62 examined, and among dippers' helpers a rate of 4.0 per cent out of 149 examined. If we combine the positive and presumptive cases among the men, the highest rates are among the dippers, the glaze mixers, and the oddmen, respectively; and among the women, dippers' helpers and ware gatherers, in the order named.

It should perhaps be explained that the rate of plumbism among ware cleaners and among brushers is found to be approximately the same, so that we have included brushers under ware cleaners in the above table. We examined only those brushers who are working in rooms in which they come in contact with lead or with lead dust. We do not include any bisque-ware brushers, who are not exposed to lead.

A careful analysis is made of the occupational groups and of the rates shown in Table XLV, for the purpose of adjusting these rates according to age of employees and according to length of exposure. Table XLVI gives the classification of these rates and shows both the actual rate for each occupation and the expected rate for each age group and for each period of exposure.

TABLE XLVI.—*Actual occupational rate of plumbism and expected rates of these groups affected, by age and exposure.*

Occupation.	Men.			Women.		
	Actual rate.	Expected rate.		Actual rate.	Expected rate.	
		By age groups.	By length of exposure.		By age groups.	By length of exposure.
Foremen	5.1	10.8	10.9	0.0	3.9	4.0
Glaze mixer	9.8	9.7	6.9	....	....	....
Dipper	17.2	8.6	10.4	0.0	4.7	3.6
Dipper's helper	5.6	5.0	4.5	4.0	3.1	2.7
Ware carrier and gatherer	0.0	5.5	4.5	4.8	3.0	3.0
Ware cleaner	0.0	4.0	3.7	3.1	3.4	2.7
Glost-kiln placer	6.9	7.6	10.7	....	....	....
Kiln fireman	16.7	16.5	12.1	....	....	....
Kiln drawer	0.0	5.2	6.5	0.0	4.6	3.8
Oddman	10.1	10.1	6.6	....	....	....
Sagger washer	4.7	9.3	6.9	....	....	....
Decorator	15.4	7.9	5.5	5.3	3.3	3.4
Total	8.8	....	....	3.5	....	....

It will be noted that the actual rate of positive plumbism for foremen, which is 5.1 per cent, is somewhat less than might be expected of this group because of age and because of the length of time they have worked in the lead hazard. The foremen are somewhat older than the average for the male potters, so that a rate of 10.8 might be expected due to their distribution among the various age groups. They have been exposed to the lead hazard somewhat longer than has the average male employee under discussion, such that a rate of 10.9 might be expected because of their length of exposure. The low actual rate for foremen is no doubt due to the fact that their occupation has less hazards as far as lead is concerned.

In some occupations the actual rate is higher than the expected rates; in some it is lower. In other occupations there are hardly sufficient cases to make the rates reliable. However, in six of the male occupations there ought to be a sufficient number of cases to make the comparison of these rates possible. The glaze mixers, dippers, and dippers' helpers have actual rates of positive plumbism higher than might be expected of these various occupations, because of age and because of length of exposure. The ware carriers, gloost-kiln placers, and sagger washers have rates somewhat lower than the expected rate. Among the women workers the dippers' helpers and the ware gatherers have rates higher than the expected rates, while ware cleaners have about the rate that might be expected due to their ages and years of exposure. In the other female occupations there are perhaps insufficient numbers for placing any great reliability in the comparison of rates. It seems, however, that in the six male occupations and in the three female occupations mentioned there are sufficient numbers to make a comparison of rates significant.

No attempt is made here to show what the combined effects are of age and of length of exposure upon these occupational rates, largely because we are unable to assign satisfactory weights to these factors. The sex differences among dippers' helpers and among ware carriers have already been noted. There are not sufficient numbers in any of the other occupations to make possible a reliable comparison.

NATIONALITY.

Table XLVII shows plumbism among some of the various nationalities found employed in the potteries included in this survey. There is not a sufficient number of workers of the various nationalities represented to make all the rates reliable, so that rates are given for only Americans, English, Irish, and Italians, and a combined rate for Germans, Hungarians, and Austrians. All other nations are grouped together for a rate of plumbism.

TABLE XLVII.—*Plumbism according to nationality, by sexes.*

MEN.

Nationality.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism. Positive.	Rate of plumbism. Positive and presumptive.
American and not given	97	60	102	878	8.5	13.8
English	13	8	8	62	14.3	23.1
Irish	4	2	3	29	10.4	15.8
Italian	0	3	3	34	0.0	7.5
German, Hungarian, and Austrian	6	3	10	64	7.2	10.8
Others	6	2	3	36	12.8	17.0
Total	126	78	129	1,103	8.8	14.2

WOMEN.

Nationality.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism. Positive.	Rate of plumbism. Positive and presumptive.
American and not given	11	26	37	250	3.4	11.4
English		1	1	6	0.0	12.5
Irish	2	1	1	6	20.0	30.0
Italian				1	0.0	0.0
German, Hungarian, and Austrian				9	0.0	0.0
Others				21	0.0	0.0
Total	13	28	39	293	3.5	11.0

As has been shown before, the greater per cent of the workers are Americans. The rate for this group is about the normal rate for the whole group. The 91 Englishmen have the highest rate of positive plumbism, which is 14.3 per cent, and of positive and presumptive, which is 23.1 per cent. The lowest rate is among the Italians, 40 of this nationality having a rate of positive plumbism of 0.0 per cent, and of positive and presumptive of 7.5 per cent. Questions arise as to racial tolerance and to racial susceptibility to lead poisoning.

To ascertain whether nationality is a factor in determining plumbism, or rather whether some races are more susceptible to lead poisoning than others, these figures are analyzed rather carefully. Among the Englishmen are found a relatively larger number of dippers and of those in the more hazardous occupations than is found in the group as a whole. As there are no standards for eliminating the various occupational groups, the rates furnished in this study are taken as a basis for computing the rate of plumbism according to the number of Englishmen in the various hazardous occupations. Positives and presumptives are considered together in making this analysis. This gives us a rate of 14.7 per cent for the expected rate of positive and presumptive plumbism with the occupations of the English workers, provided the same rates exist as in the occupations of the whole group. This is a slightly higher rate than the average rate of positive and presumptive plumbism for the whole study, which is 14.2 per cent.

Moreover, the average age of the Englishmen is 46.5 years, which is about 8 years more than the average age of the 1,436 men examined in this survey. Applying the same methods to the age groups as we have applied to the occupational groups, we get a rate of positive and presumptive plumbism of 16.8 per cent for the English age groups. In the matter of length of exposure it is found that the Englishmen were exposed somewhat longer than the average period for all males examined. Applying methods of standardization again, it is found that the length of exposure for these men gives an expected rate for positive and presumptive plumbism of 17.3 per cent. We have not yet discussed the effect of tea, coffee, tobacco, nor liquors, but it is found that the Englishmen use somewhat more than that used by the average pottery working men, so that a rate of positive and presumptive plumbism of 15.6 per cent might be expected because of the use of these articles.

Summarizing these facts concerning the English male workers, it might be said that they are in more hazardous occupations, they represent an older group, they have been exposed to lead hazards longer, and their personal habits are such that we might expect them to have the higher rate of positive and presumptive plumbism noted in Table XLVII. While there are perhaps no recognized processes of weighing the above rates when we accumulate them into a single factor, yet if we combine the increase of each over that of the rate of positive and presumptive plumbism for all males, we get an expected rate of 23.4, when all factors are considered to have an equal effect in determining the rate of positive and presumptive plumbism. This resulting rate is approximately the same as the actual rate found—namely, 23.1 per cent.

In analyzing also the facts concerning the 40 Italian workers whose rate of positive and presumptive plumbism has been shown before to be 7.5 per cent, we find a large number of these are in the less hazardous occupations, as a relatively few of them are dippers or glaze mixers. Standardizing these groups, we get a rate of positive and presumptive plumbism of 12.5 per cent, which might be expected of a chance group distributed as these Italians are among the various pottery occupations. The average age of the group is 34 years, which is about 5 years younger than the whole group of male workers. The standardized rate of positive and presumptive plumbism for the Italian age group is 13.3 per cent. They have been exposed to the lead hazards for an average of 5.2 years, which would give a rate of positive and presumptive plumbism of 11.0 per cent. While we have not discussed plant hygiene, it is discovered also that the Italians are distributed among plants in which hygienic conditions are slightly above the average. In fact, the rate of positive and presumptive plumbism for the type of plants in which these Italian workers are found is 10.8. Combining these facts—namely, less hazardous occupations, less age of workers, a reduced length of exposure, and better factory conditions under which these men work—it is not surprising that they have such a low rate of lead poisoning. If we accumulate the various reductions, as shown in the above rates, by a simple process of multiplication and equal weighing for all factors, we get a resultant rate of 7.49, which very closely approximates the positive and presumptive rate of 7.5.

Although the number of men in each of these nationalities is not large, it is safe to say that our analysis does not show a race hazard. In other words, no particular race is found to be more susceptible to lead poisoning than another, nor does any race seem to show tolerance for lead poisoning. It is acknowledged, however, that a study of a larger group of these nationalities would make the conclusions more reliable. The facts concerning the other nationalities are not analyzed. Due to the fact that most of the pottery workers are Americans and that we are unable to show racial differences here, no attempt is made in this report to adjust for racial differences.

LENGTH OF DAY.

Table XLVIII shows the rate of plumbism for the male workers according to the number of hours per day. It should be noted that a great many of these men work by the piece and that the length of day varies materially within a given plant and for a given worker, and that these figures represent a typical day for the worker. Where the plants are considered, the time represents a typical time for the majority of the workers within the plant.

TABLE XLVIII.—*Plumbism according to length of day.*

	Length of day.			
	7 hours and less.	8 hours.	9 hours.	10 hours and more.
Number of workers	255	702	310	93
Actual rate of plumbism	7.9	9.8	6.5	11.2
Expected rate for occupation	9.4	8.8	8.1	9.4
Expected rate for exposure	10.5	9.9	7.7	7.9
Number bad conditions	Average.	Below.	Above.	Average.

It will be observed that the rate of positive plumbism for those working 7 hours per day and less is 7.9; for those working 8 hours, it is 9.8; for those working 9 hours it is 6.5; and for those working 10 hours or more, it is 11.2. These rates increase as the length of day increases, with the exception of those working a 9-hour day. The conditions are therefore analyzed a little further in order to discover whether there are other factors which would tend to affect these rates of positive plumbism for those working different hours per day. Those employed for 9 hours per day are in occupations slightly less hazardous than are those employed for the other lengths of day. Those working on a 9-hour schedule have had a less exposure than those working under the other lengths of day. It is found also that those plants in which the 9-hour schedule seems to prevail have fewer bad conditions which would tend to affect the health of the worker and to increase the rate of positive plumbism. Reference to the table shows us that the expected rate for the occupation of the 9-hour group is 8.1, and for the length of exposure of this same group it is 7.7. The age distribution for each group is about normal. An adjustment of these rates would tend to increase the rate of plumbism for those working 9 hours per day, and it would also tend to decrease about equally the rates given in Table XLVIII both for those working both 7 hours per day and less and for those working 8 hours per day. This would tend to give us an increasing rate of positive plumbism as the length of day increases. The glost kiln men, who work less than 7 hours per day, have no positive cases of lead poisoning among the small number of examinees. Those kiln men who have a 7 hour day have a rate of positive plumbism of 7.3 per cent while those with an 8-hour day have a positive rate of 8.8 per cent. Those in the 7-hour group are slightly overaged and overexposed, so that an adjusted rate would be less than 7.3 per cent. There are not enough kiln men employed 9 or more hours per day to give a reliable rate. These results indicate that length of day increases the probability of getting lead poisoning.

TIME AND PIECE WORK.

In trying to show the difference in the rate of plumbism for those workers who are hired by the piece and for those who work by the day certain difficulties present themselves. The first is that the pieceworker, as a rule, is the man who hires the rest of the crew who work under his direction. He therefore sets the pace himself. The main difference perhaps is that the timeworker, though he may not be allowed more time for lunch, will take more time for getting drinking water, for visiting toilets and washrooms, and for getting in, where possible, short periods of rest and recreation. Our observations confirm this statement. In a measure, then, the pace setting may be reversed, and the pieceworker in order to maintain his speed must employ more helpers. However, 844 male pieceworkers have a rate of positive plumbism of 9.1, while 461 male timeworkers have a like rate of 5.8. These same pieceworkers have a rate for positive and presumptive plumbism of 15.3, while the timeworkers have a rate of 10.4. Likewise 23 women working by the piece have a positive and presumptive rate of plumbism of 13, while 277 female timeworkers have a rate of 10.8.

Analysis of the male timeworkers shows that they are slightly underaged and slightly underexposed, as far as occupational hazards are concerned; whereas the pieceworkers are slightly overaged and slightly overexposed. These two items, however, are insignificant in adjusting the rates. In the matter of length of exposure the timeworkers are underexposed and the pieceworkers are overexposed to a degree sufficient to account for a considerable part of the differences in rates noted. Evaluating for these differences, it still appears that pieceworkers have a higher rate of lead poisoning than timeworkers have.

PERSONAL HABITS.

EATING IN THE WORKROOM.

Table XLIX gives the rates of plumbism by sexes for those who eat regularly in the workrooms where lead is present and for those who do not.

TABLE XLIX.—*Plumbism for those who eat in the workrooms where lead is present.*

Eat in workroom.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
					Positive.	Positive and presumptive.
MALE.						
Do regularly	89	54	84	742	9.2	14.8
Do not	37	24	45	361	7.9	13.1
FEMALE.						
Do regularly	6	17	24	93	4.3	16.4
Do not	7	11	15	200	3.0	7.7

As shown in this table, the rate of positive plumbism for those males who eat regularly in the workroom is 9.2 and for those who do not it is 7.9. For the female the rates are 4.3 and 3.0, respectively. If we include positive and presumptive cases, we get a rate of 14.8 for those males who eat in the workrooms and of 13.1 for those who do not. The corresponding rates for the females are 16.4 and 7.7. We find after analysis that those who eat in the workrooms have about the same distribution among the various occupations of the pottery industry as those who do not. This is true for both sexes. However, the men who eat in the workrooms are slightly underaged and slightly underexposed, as compared with the group that does not eat in the workroom. This is perhaps sufficient to increase the difference in positive rates noted between these groups by as much as 1 or more per cent. The women who eat in the workrooms are somewhat older and longer exposed than the women who do not eat in the workrooms. The average age of the women who eat in the workrooms is 32.4. These two factors would tend to decrease the difference in rates of positive plumbism between these two groups of women workers by as much as a fraction of 1 per cent. It is perhaps sufficient to state that where groups of equal age, exposure, and of like occupations are considered a slightly greater difference in the rates for the two groups would result for the men and a slightly less difference would result for the women than those shown in Table XLIX.

It is evident that the rates of plumbism are higher for those who eat in workrooms where lead is present than they are for those who eat elsewhere. There is every reason to suspect that if we eliminate eating in the workrooms we may be able to reduce the amount of lead poisoning after a reasonable length of time. There is no good reason for claiming that our rates are refined to the extent that an estimate can be made of the exact amount of such reduction.

USE OF MILK, TEA, COFFEE, TOBACCO, AND LIQUORS.

In discussing personal habits among the workers and in trying to find what effect they may have upon the rate of plumbism among pottery workers, it is perhaps necessary to acknowledge that we are unable to get reliable data upon certain habits which are probably factors and which should be considered. While our investigators saw factory workers putting glaze-covered fingers into their mouths and saw men stroking their beards and leaving lead glaze in the vicinity of the mouth, yet it is impossible to get sufficient reliable data concerning habits of this kind which will lend themselves readily to statistical analysis. It is necessary, therefore, to confine a discussion of personal habits largely to habits of eating and drinking. During an examination of the individual, therefore, data were collected with reference to the use of milk, tea, coffee, tobacco, and intoxicating liquors. Data collected concerning these matters and the rates of plumbism for those accustomed or addicted to the use of these various articles are shown in Table L.

TABLE L.—*Plumbism according to certain personal habits of the workers, by sexes.*

Personal habits.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
					Positive.	Positive and presumptive.
Drink milk:						
Male	21	19	18	249	6.8	13.0
Female	....	1	5	31	0.0	3.1
Drink tea:						
Male	56	32	49	417	10.1	15.9
Female	4	9	15	74	3.9	12.8
Drink coffee:						
Male	92	68	104	788	8.5	15.2
Female	11	23	29	206	4.1	12.7
Chew tobacco:						
Male	44	33	43	412	8.3	14.8
Female	....	....	1	1	0.0	0.0
Smoke:						
Male	63	48	85	647	7.5	15.2
Female	1	....	1	....	50.0	50.0
Use liquors to excess:						
Male	15	3	8	79	14.3	17.1
Female	....	1	4	7	0.0	8.3
Drink tea and coffee:						
Male	50	32	45	353	10.4	17.1
Female	3	7	9	58	3.9	13.0
Chew and smoke:						
Male	28	20	28	245	8.7	15.0
Female	0	0	0	0	0.0	0.0
Use tobacco to excess:						
Male	34	19	25	252	10.3	13.0
Female	0	0	0	0	0.0	0.0
Drink tea or coffee and chew or smoke and use liquors: Male	45	23	48	360	9.4	14.3
Actual rates:						
Male	....	....	....	....	8.8	14.2
Female	....	....	....	....	3.5	11.0

This table shows us that the rate of plumbism for those who drink milk is somewhat lower than it is for those who drink tea. For those who drink coffee it is somewhat higher than the rate for the whole group. For those who drink liquors to excess the rate is considerably higher than it is for the whole group. For those who drink both tea and coffee the rate for both sexes is considerably higher. For those who drink tea or coffee and who either chew or smoke and who use liquors the rate is slightly higher than it is for the whole group. It seems, therefore, that these figures indicate that the use of milk is a deterrent. Tea, coffee, tobacco, and liquors, especially when used to excess, tend to increase the rate of lead poisoning. The milk drinkers seem to distribute themselves quite normally among the age groups, periods of exposure, and occupations as far as both sexes are concerned.

A further analysis is made of the tea drinkers in order to find whether the increased rate noted among the men and women who drink tea might be due to some other factors. The men who belong to this group are distributed rather evenly throughout the various occupations, so that no increased rate may be expected because of their following more hazardous occupations. They are, however, slightly older than the average of the whole group of men working in the potteries, so that an expected rate of 9.1 is found, because of their distribution among the various age groups. They have been exposed to lead hazards somewhat longer than the average male potter so that an expected rate of 9.9 would result because of this factor. As far as these two factors are concerned, they seem to account for the higher rate of positive plumbism—namely, 10.1—among the male tea drinkers.

It is found that the women who drink tea are in less hazardous occupations, and that they are underaged and underexposed, as compared with the whole group of women. All these factors would tend to decrease materially the rate of plumbism in this group, so that unless there are other factors, it would appear that the women workers who drink tea have a higher rate of plumbism than might be expected of them. We are not able to tell how much of the tea drinking is due to a desire upon the part of the victims to rid themselves of a metallic taste resulting from lead poisoning, and therefore whether it is an effect rather than a cause.

A further analysis of the excessive users of tobacco is made in order to find whether the increased rate of plumbism noted among this group may be due to some other factors. They are distributed through the various age groups rather normally, so that the expected rate of plumbism on account of age is not increased. They have a normal distribution among the various occupations, so that the increased rate is not due to occupational hazards. In the matter of years of exposure they are slightly overexposed as compared with the whole group of male workers, so that an expected rate of 9.4 would result because of length of exposure. As far as other causative factors are concerned, those affecting the men who use tobacco to excess seem to be about normal.

Although we are not able to make a definite statement in regard to the effect of tea upon plumbism, our analysis seems to enable us to say that the higher rate of plumbism for those using tobacco to excess, as shown in Table L, can not be charged to age, length of exposure, or additional occupational hazard. Our results fail to confirm the contention that the use of tobacco tends to allay lead poisoning.

In analyzing the group known as "those using liquors to excess" we find that they are slightly overaged, so that an expected rate of 9.9 would result, because of their distribution among the various age groups. They are also slightly overexposed, so that a rate 9.6 might be expected, due to their length of exposure. In analyzing their distribution among the various occupations it appears that they are in slightly more hazardous occupations than the average male in the whole group examined in this survey. An expected occupational rate of 9.5 would result, due to their distribution among the various occupations.

With respect to the analysis of the smokers, it is found that they are slightly underaged, that they have about a normal distribution among the occupations, and they are slightly overexposed as compared with the whole group of male workers included in this report. These three factors perhaps balance each other, so that the smoking group may be considered normal as far as these influencing factors are concerned.

TRADE HAZARDS.

INQUIRY INTO THE EFFECT OF SOLUBLE LEAD IN THE GLAZE.

Up to this point we have discussed plumbism mainly from the viewpoint of the individual and from his personal habits. We shall now inquire into the relation of plumbism with respect to the amount of soluble lead used in the various glazes examined. As we have stated before, we collected 107 samples of glaze from 87 plants. The amount of soluble lead in these glazes varies from 0.0 per cent to 45.70 per cent, and no leadless glazes were found.

Throughout this report we have referred to lead as the exciting cause of plumbism, and our purpose here is to discover whether a larger amount of lead in the glaze has a tendency to cause a higher rate of plumbism. Table LI shows the distribution of cases of lead poisoning according to the diagnosis among plants having a per cent of soluble lead of less than 12 and among those having 12 per cent or over of soluble lead. This point of division is selected because it divides the modal group in Table XVII, where it is shown that 65 plants have from 10 per cent to 14 per cent of soluble lead in their glaze.

TABLE LI.—*Plumbism according to the amount of soluble lead used in the glaze.*

Per cent of soluble lead.	Number of plants.	Sex.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
							Positive.	Positive and presumptive.
12	60	M.	104	70	102	714	10.5	17.6
		F.	12	26	31	188	4.7	14.8
0–11.9	27	M.	21	7	24	357	5.1	6.8
		F.	1	2	6	102	.9	2.7
No report	5	M.	1	1	3	32	2.7	5.4
		F.	0	0	2	3	.0	.0
Total	92	M.	126	78	129	1,103	8.8	14.2
		F.	13	28	39	293	3.5	11.0

A survey of this table brings out the fact that the 60 plants having over 12 per cent of soluble lead in the glaze have a rate of positive plumbism of 10.5 among the men and 4.7 among the women. Those plants having less than 12 per cent of soluble lead in the glaze have a rate of positive plumbism of 5.1 among the men and of 0.9 among the women. The five plants which failed to furnish sample of the glaze have a rate of 2.7 per cent of positive lead cases among the men and none among the women. If we combine positive and presumptive cases, we get a rate of 17.6 for the men and 14.8 for the women where the glaze contains over 12 per cent of soluble lead, and 6.8 for the men and 2.7 for the women where it contains a less amount of soluble lead. In analyzing the differences between these two groups, the one working in glaze containing 12 per cent and over of lead and the other working in glaze containing less, we find about the normal distribution for both sexes as far as occupation is concerned. However, both the men and the women are about two years underaged and about one year underexposed in the plants having the higher per cent of soluble lead in the glaze. This would tend to increase by a slight amount the difference shown in Table LI.

Further analysis by using more than two classes of the per cent of soluble lead in glaze shows that there is not a direct correlation between the amount of soluble lead used and the rate of plumbism. In fact, some of the plants have a very high per cent of soluble lead in glaze and a reasonably low per cent of plumbism. There are so many factors affecting plumbism that a further analysis of conditions is necessary. This will be discussed under plant hygiene. Under similar conditions, however, we may expect lead poisoning to decrease as the soluble lead content of the glaze decreases and to disappear entirely if leadless glazes are used.

PLUMBISM BY WARES.

In Table XX the cases of plumbism are enumerated under the various kinds of ware manufactured by those potteries coming under our survey. In Table LII we have a summary of the cases of lead poisoning according to diagnosis distributed among the various wares which are being manufactured. Since there are very few plants manufacturing yellow ware, art ware, and tile, these are included together, so that we have in this table the headings "General Ware," "Sanitary Ware," and "Others."

TABLE LII.—*Plumbism by ware, sex, and diagnosis.*

Ware.	Men.				Women.				Rate of plumbism.	
	Positive.	Presumptive.	Suggestive.	Negative.	Positive.	Presumptive.	Suggestive.	Negative.	Positive.	Positive and presumptive.
General	101	60	103	737	18	26	32	246	8.6	15.2
Sanitary	20	12	19	238	0	2	1	8	6.8	11.6
Others	5	6	7	128	0	0	6	39	2.6	5.8
Total	126	78	129	1,103	13	28	39	293	7.7	13.5

It will be observed that the rate of positive plumbism for general ware is highest, being 8.6 per cent; that sanitary ware comes next, with a rate of 6.8 per cent; and the other ware is lowest, with a rate of 2.6 per cent. These rates do not follow the rates worked out in Table LI for the amount of soluble lead in the glaze, inasmuch as plants under the heading "Others" usually have a rather high per cent of lead in the glaze samples which they gave us for analysis. It is claimed by the chemists of these plants that for certain types of ware a glaze with a low content of lead is in use. There are also certain factors of plant hygiene which we shall consider later and which enter as factors in determining rates of plumbism. The general ware plants have a number of unhygienic conditions not found in the other groups. It is found that the general ware plants and the sanitary ware plants have age and length of exposure conditions slightly above normal, while those in the other group are about three years underexposed and four years underaged. These other factors help us to account for a large part of the differences in the rates of plumbism noted in these two groups.

SIZE OF PLANT.

Table LIII shows by sexes and by diagnosis the number and the rate of lead cases according to the size of the plant.

TABLE LIII.—*Rates of plumbism according to size of plant.*

Size (employees).	Men.				Women.				Rate of positive plumbism.	
	Positive.	Presumptive.	Suggestive.	Negative.	Positive.	Presumptive.	Suggestive.	Negative.	Men.	Women.
0–50	1	2	3	29	0	0	2	2	2.9	0.0
51–100	5	7	6	89	2	1	2	6	4.7	18.2
101–250	43	40	53	597	6	10	20	160	5.9	3.1
251–500	38	18	48	262	2	8	9	68	10.4	2.3
501	39	11	19	126	3	9	6	57	20.0	4.0
Total	126	78	129	1,103	13	28	39	293	8.8	3.5

We observe that plants having 50 or less employees have a rate of 2.9 of positive plumbism for men. It is stated by the chemists of these plants that for certain types of ware a glaze with a low content of lead is in use. Plants having between 51 and 100 employees have a rate of 4.7 positive plumbism, those employing 101 to 250 persons have a rate of 5.9 per cent, those employing between 250 and 500 have a rate of 10.4 per cent, and those employing more than 500 have a rate of 20.0. Corresponding rates for women workers are 0.0 per cent, 18.2, 3.1, 2.3, and 4.0 per cent. The rates for men for both positive and presumptive plumbism are 8.6, 11.2, 11.3, 15.3, 25.6, and for women they are 0.0, 27.3, 8.2, 11.5, and 16.0. With the exception of plants having from 51 to 100 employees, there is among both sexes a gradual increase in positive and presumptive plumbism, and among the men in positive plumbism as the size of the plant increases. The small number of women in both the lower groups of plants give unreliable rates as only four women were examined in plants of 50 or less employees, and only 11 in plants having from 51 to 100 employees. With these exceptions it may be stated in a general way that the larger plant has a greater per cent of lead poisoning.

The sex distribution is given in the above table. The age and occupational distributions are about normal for each group. It might be supposed that the larger plants retain their employees for a greater number of years and on this account plumbism accumulates there. It might be stated here that the average length of exposure in the small group of plants is 10.1 years and in the next larger it is 11.3, then 9.4 years, 8.8 years, and in the larger group of plants 10.9 years. It seems, therefore, that as far as length of service is concerned, no credit is to be given to larger plants because of greater years of exposure. However, a greater actual exposure may be obtained in the same length of time in a large plant than may be obtained in a small plant.

For example, the glaze mixer in a small plant is usually exposed to the lead hazard for no more than two or three hours per day, whereas in the larger plant he may be exposed to lead continually. In one small plant with less than 100 employees the glaze mixing is done once a week normally, but at the time of the survey mixing was being done every three weeks. The mixing process occupies about an hour. In another small plant glaze mixing occupies about one hour per week. In a third small plant the process of mixing dry materials occupies about one hour twice a week and during the operation the glaze mixer spends probably half of the time in the room. The handling of the dry lead occupies no more than five or ten minutes of each glaze-mixing period, so that the mixer is not exposed to the dry lead dust to exceed 20 minutes in a week. In several small plants the average number of mixtures of glaze per week is about five, and the length of time of mixing varies from 20 to 40 minutes. In the larger plants, however, the glaze mixer works full time, the hours of actual exposure varying from 15 to 42 per week.

Likewise the dipper in the small plant has a less actual exposure than he has in the large plant. In one small plant the dipper carries in the bisque ware, and during that time does not come in contact with lead; in another the dipper is actually dipping about three days per week, and in another there are two dippers on part time. In a fourth the dipper is obliged to work at a different occupation part of the time, because there is not enough work at that pottery to keep him busy at his particular trade. In the larger plants the dipper has little opportunity to get away from the lead hazard. The glost-kiln placer in the small plant often works half of the time in the bisque kiln, where no lead hazard exists. In the larger plant he is kept busy setting ware, in an atmosphere of lead dust. What is true concerning the exposure in these occupations is also true, in a great measure, in all other hazardous occupations in the pottery industry.

The significance of this distribution of cases of plumbism according to size of plant has already been referred to. In a previous section we showed the advantage of size of plant with respect to the installation of sanitary facilities. The recommendations which we shall give under section V will cover these points carefully. There is another cause operating against conditions in the larger plants which will be taken up more fully under the discussion of plant hygiene. This has to do with the responsibility of cleaning up the various rooms of the plant and with keeping certain sanitary conditions in operation under the prevailing system of piecework.

PLANT HYGIENE.

In the previous pages of this section we have discussed those factors which have to do with the worker and his personal habits, and we have concluded with a discussion of plumbism with respect to the amount of lead used in the glaze, with the rates of plumbism among the different wares manufactured, and with respect to the size of the plant. With the exception of these three latter points, our attempt has been to include only those factors over which the employer has little or no control.

Hygienic conditions in the potteries have already been discussed in a previous section, and certain tables have been presented to show what conditions were found and what desirable facilities and conditions were absent in these several plants coming within the scope of our survey. We will attempt now to deal more particularly with those conditions in the plant over which the employer may be expected to have control and for which he should be held responsible. Our first study is an attempt to find whether a combination of bad conditions with respect to air dustiness, personal facilities, toilets, and certain hazards appears to be responsible for high rates of lead poisoning. If so, plumbism will then be studied with respect to dust and the various conditions which would tend to create dust and which would be recognized as factors in making dust a hazard in the incidence of plumbism.

Personal facilities will be discussed later, such as the provision of proper drinking vessels and water containers; provision of a place to eat lunches; washing facilities; provision of soap and towels; provision of special clothing; furnishing of lockers and of bathing facilities, and the matter of keeping the workers instructed in the dangers arising from the use of lead.

We shall also discuss the toilet provisions, together with their adequacy and availability and sanitation, and the connection which these various plants have with proper sewage disposal. We shall also discuss certain hazards, including those of cold, heat, moisture, and fatigue, and shall show the rates of plumbism as affected by all the foregoing conditions, as well as by the pieceworking method in use in certain plants.

Briefly stated, it is the purpose to show here what effect these conditions may have upon the health of the worker, especially with reference to his having lead poisoning. The per cent of plumbism will be shown in plants where sanitary conditions are considered poor as compared with those where sanitary conditions are satisfactory. Plumbism will be related to as many of these conditions as possible, in order to determine, if at all feasible, whether any of the incidence of plumbism may be attributed to plant conditions. An attempt will be made so far as possible to analyze these conditions with respect to each other and with respect to matters of age, exposure, and occupation as set forth in the previous pages.

An attempt is made to combine the effects of several of these plant conditions by taking 10 of those considered most prominent. These include dirty ware boards, splash and spill of glaze, dry sweeping, sweeping during working hours, poor ventilation, poor illumination—all these having to do with air dustiness—bad toilets, and such personal facilities as open water pails, eating in the workrooms, and poor washing facilities. Eight plants are found with as many as eight of these ten conditions. The 162 persons examined in these eight plants have a rate of positive plumbism of 18.5 per cent and a positive and presumptive rate of 34 per cent. Twenty-nine plants are found with not more than three of these conditions, where the 489 persons examined have a rate of positive plumbism of 3.3 per cent and a positive and presumptive rate of 6.3 per cent. Personal factors do not change these rates materially. There are many other unhygienic plant conditions, although perhaps of minor importance, which have not been eliminated, so that the whole difference in these rates may not properly be charged to the conditions enumerated above. It is perhaps sufficient to note that the difference in these rates may be expected to be greatly reduced by an elimination of these unsatisfactory conditions of plant hygiene.

Chart 7 shows in graphic manner the relation of positive plumbism in 92 plants with the incidence of the 10 conditions enumerated above. In this figure the 92 plants are arrayed from that having the highest rate of positive plumbism at the left of the figure to those with no positive plumbism at the right of the figure. Those plants with no positive plumbism are arrayed according to the number of unhygienic conditions. The curve showing the number of unhygienic conditions is smoothed by a moving average. These curves run surprisingly close together.

If the foregoing analysis indicates, as it seems to do, a higher rate of plumbism in plants where there is a larger number of insanitary conditions, then, in all probability, these single conditions may share in the series of rates showing the incidence of lead poisoning. On the other hand, certain factors which have been included may be given undue weight. Further analysis, then, becomes necessary in order to estimate relative values of single factors. Even then caution must be exercised in accepting these rates as final, because it must be remembered the limitations of this survey do not permit that refinement of analysis which can segregate a single factor from all others to the extent that we have its individual weight uninfluenced by the presence of other factors. The best that such analysis as we are able to use can show is that our series of rates of plumbism is about constant as we separate or combine for effect of unhygienic conditions.

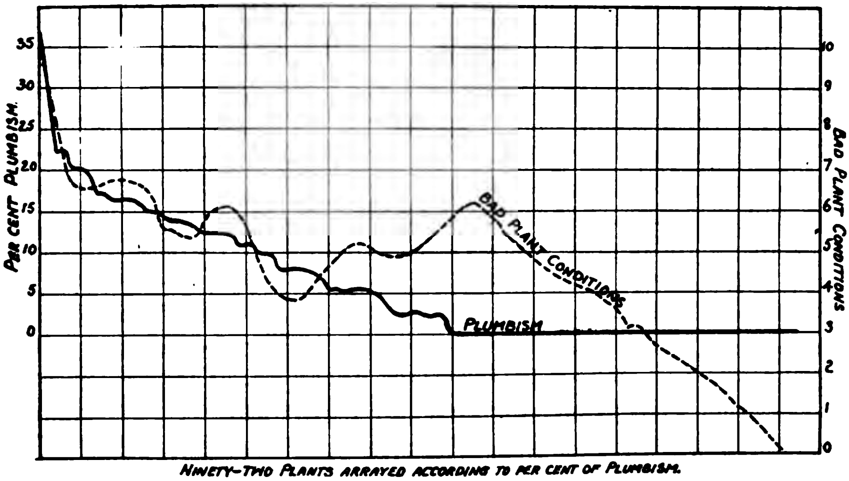

CHART 7.—Comparison of per cent of positive plumbism in potteries with 10 plant hygiene conditions.

AIR DUSTINESS.

In considering air dustiness there are several factors which need separate attention. First there are sources of dust, which include lack of cleanliness of ware board, splash and spill of glaze, and open glaze containers. Then there are factors which have to do with stirring up dust so that it becomes suspended in the air, where it is breathed into the lungs of the workers. These include dry sweeping and sweeping during work hours or while workers are present. Lack of respirators, poor ventilation, and poor illumination all have to do with the prevention of dust hazards and need consideration, as well as does the dust content, both with respect to number of particles in the air and the amount of soluble lead.

We first attempt to find whether air dustiness, including all the factors enumerated above, has an effect in producing high rates of plumbism, and if so, to determine later whether any part of such rates may be charged to a single factor.

In trying for an estimate of the effect of the nine factors enumerated which have to do with the source and amount and lead content of dust in these potteries, certain difficulties arise. The first difficulty is that no plant is found which has none of these factors, and only one plant is found which has them all. By taking plants with an amount of dust exceeding 200,000 particles per cubic foot and those with ware boards creating sufficient dust to cause annoyance or complaint and those plants with considerable splash and spill and in which dry sweeping is practiced, we get a group where approximately 200 persons were examined for lead poisoning in which the rate of positive plumbism is found to be 12.0. The positive and presumptive rate is 23.9. An analysis of this group shows us that the workers are slightly overaged and slightly overexposed as compared with all the potters, but engaged in slightly less hazardous occupations. That is, there are fewer dippers and fewer glaze mixers than would be expected in a group as large as this. The sex distribution is about equal. It seems, therefore, as far as personal factors other than personal hygiene are concerned, that they do not play a large part in this high rate of plumbism.

If we consider a group of plants having no more than one of the four conditions mentioned above and some of the other five conditions enumerated, we get a rate of positive plumbism of 1.1 and a positive and presumptive rate of 3.1 in a group of approximately 350 examinees where the occupational rate is normal and where the age and exposure rates are slightly under the average for the whole group of potters and where the sex distribution is about normal. This would tend to increase slightly the positive rate of 1.1 as found for this group. If we select a group of plants in which the dust count is less than 200,000 particles per cubic foot, in which the ware boards are kept clean, and concerning which no complaint is made in regard to dustiness from them, where the floors are well watered before they are swept, and where the conditions about the dipping tub are clean, but where some other dust factors exist, we get a rate of positive plumbism of 0.8, and a positive and presumptive rate of 2.3, out of about 130 persons examined. An analysis of this group shows that they are of average age, slightly underexposed as far as length of exposure

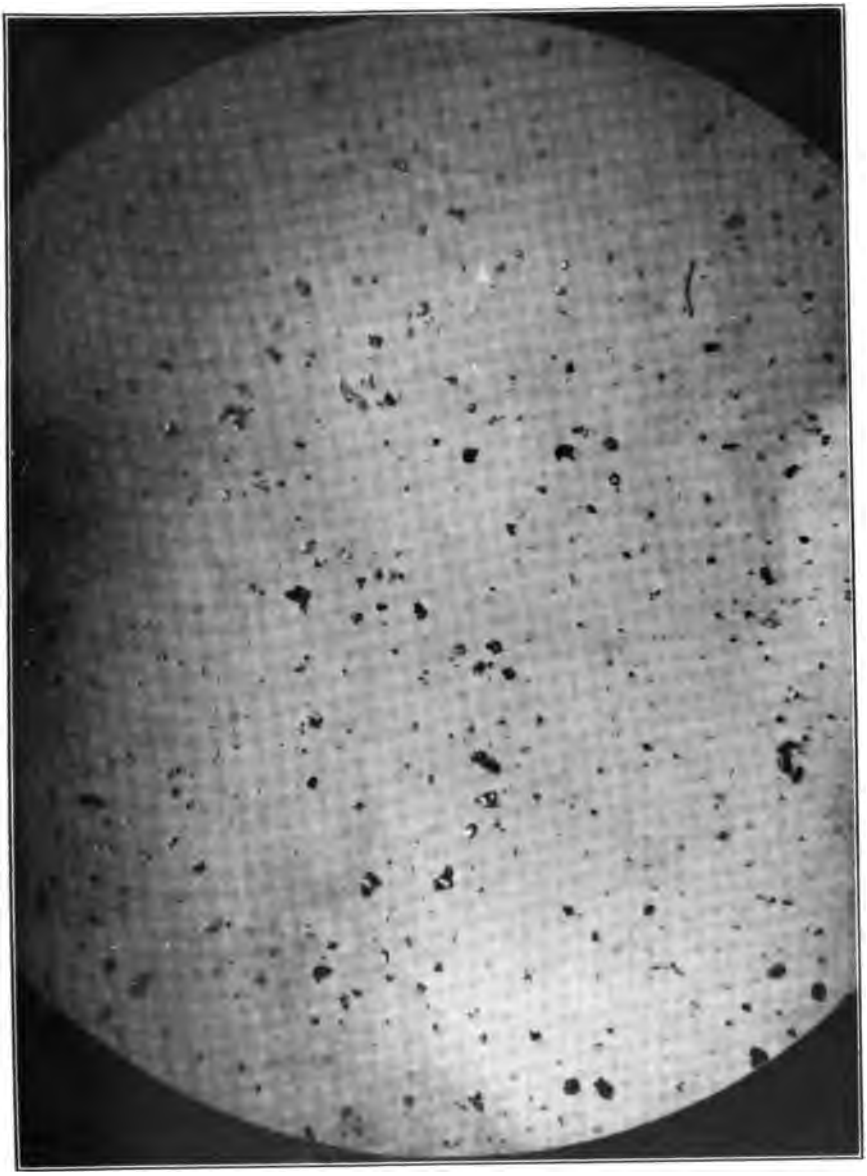

FIG. 47.—DUST SAMPLE.

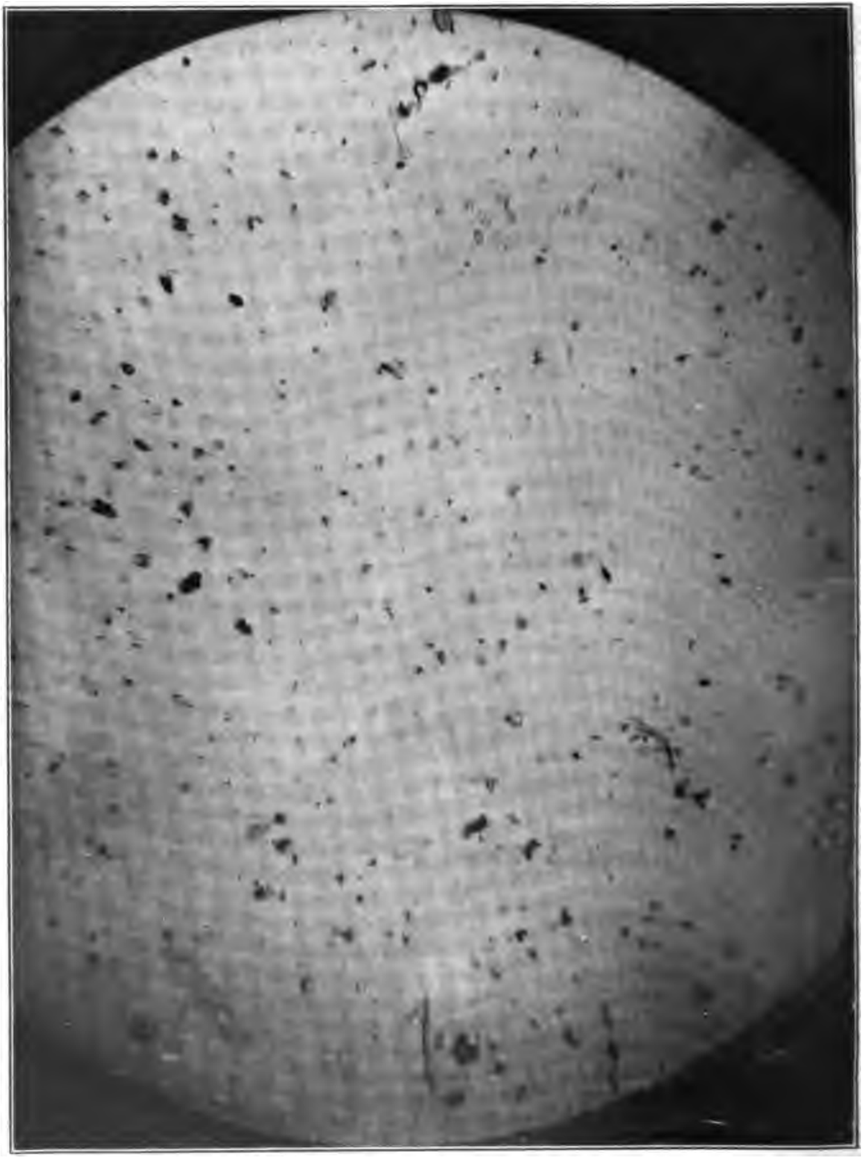

FIG. 48.—DUST SAMPLE.

is concerned, in slightly more hazardous occupations, and of normal sex distribution. It does not appear that personal factors would change this rate materially. We are not able at this point entirely to eliminate the effect of bad toilet conditions and lack of personal facilities, and thus to isolate air dustiness and to say that the differences in rates is to be charged to conditions of air dustiness alone.

Of course, it is to be remembered that these groups are small, but they are as large as it is possible to select and yet have the groups well defined as far as different elements of dustiness are concerned. It should be noted also that we have not as yet presented data with reference to the effect of other conditions of plant hygiene, including toilet facilities and other hazards studied in connection with this report. It would appear, however, that if these latter factors do not affect to any great extent the rates shown in this summary, dustiness plays a rather large part in the amount of plumbism in such a way that where there is a large amount of dust carrying a sizable lead content the rate of plumbism is sufficiently oversized to make it worth while for plant managers to expend time and money in the elimination of dust hazards and to induce the employee to be especially careful about his work, so that as little dust as possible may be stirred up where it can be breathed and ingested.

Having seen that rates of plumbism are high where groups of these factors concerning air dustiness are present, we will now try to find what effect single factors seem to have in making differences in rates. Our first analysis is concerning the dust itself, with respect to its content both as to number of particles and as to soluble lead.

DUST COUNT.

Several dust samples were collected from each plant included in this study. However, some samples were spoiled or broken in shipment, so that we have records for 66 plants. The distribution of these plants is about normal for the whole group, so that results obtained from a study of samples collected from these plants should be indicative of the results of the whole group of plants.

Table XIX gives the distribution of the potteries by rooms, according to the number of particles of dust, and according to the amount of lead in each cubic foot of air. Appendix E gives in detail the results of the examination of 346 samples taken during the course of the survey. It is our purpose here to analyze these figures and to discover, if possible, what effect the amount of dust and the per cent of soluble lead in the dust have upon the lead poisoning of the workers.

Table LIV shows the relation between dust count and lead poisoning by rooms. Under "Dipping room" are included all employees who are stationed for a greater part of the time in the dipping room, where these dust samples were taken. This includes dippers, dippers' helpers, very frequently ware cleaners, and sometimes ware carriers also. Under the "Glost-kiln room" are included glost-kiln placers, sagger washers (provided they were placed in the kiln room), oddmen (if it was found that they spent the greater part of their time in this room), and any others whose place of work in any particular plant seemed to be in the glost-kiln room. Those included under "Glaze-mixing room" are glaze mixers, glaze sifters, and glaze foremen, if their particular occupation seems to be in the glaze-mixing room.

TABLE LIV.—*Dust count and positive and presumptive plumbism, by rooms.*

	Absolute.						Per cent plumbism.		
	Under 200,000.[1]		200,000–500,000.[1]		500,000 up.[1]				
	Number of cases of plumbism.	Number examined.	Number of cases of plumbism.	Number examined.	Number of cases of plumbism.	Number examined.	Under 200,000.[1]	200,000–500,000.[1]	Over 500,000.[1]
Dipping room	7	100	37	217	40	229	7.0	17.1	17.4
Glost-kiln room	7	65	7	142	45	403	10.8	5.0	11.2
Glaze-mixing room	3	10	2	6	7	24	30.0	33.3	29.2
Total	17	175	46	365	92	656	9.7	12.6	13.9

[1] Number of particles of dust in 1 cubic foot of air.

Reference to this table shows that seven cases of positive and presumptive lead poisoning are found out of 100 of those examined who work in dipping rooms where the dust samples show less than 200,000 particles of 10 microns or under to each cubic foot of air. Thirty-seven cases are found out of 217 examined where the air dustiness amounts to between 200,000 and 500,000 particles of dust per cubic foot of air. Where there are over 500,000 particles of dust per cubic foot in the dipping room, 40 cases of positive and presumptive lead poisoning are found out of 229 examined. This gives a rate of positive and presumptive plumbism of 7.0 per cent of those in the dipping room, where the dust count is less than 200,000, of 17.1 where the dust count is over 200,000 and less than 500,000, and 17.4 where the dust count is over one-half million.

In the glost-kiln rooms the corresponding rates are 10.8, 5.0, and 11.2 per cent. In the glaze-mixing rooms the corresponding rates are 30.0 33.3, and 29.2 per cent. In the combined rooms where the dust count is less than 200,000, 17 cases of positive and presumptive lead poisoning are found out of 175 examined—which is a rate of 9.7 per cent. Where the dust count is between 200,000 and 500,000, 46 cases of positive and presumptive lead poisoning are found out of 365 examined, which gives a rate of 12.6 per cent. Where the dust count is above 500,000 particles per cubic foot, 92 cases are found out of a total of 656 examined, which gives a still higher rate of positive and presumptive plumbism—13.9. The positive and presumptive rates are 9.7, 12.6, and 13.9.

SOLUBLE LEAD IN DUST.

Table LV gives the rate of positive and presumptive lead poisoning according to the amount of soluble lead in the dust. This covers the same samples and the same rooms as those included in Table LIV. The comparisons are made for dust containing less than 5 per cent of lead, for that containing above 5 per cent and less than 10 per cent, and for that containing over 10 per cent.

TABLE LV.—*Positive and presumptive lead poisoning according to amount of soluble lead in dust.*

	Per cent of soluble lead.						Rate.		
	0-4.9.		5-9.0.		10+.		0-4.9.	5-9.9.	10+.
	Number of cases of plumbism.	Number examined.	Number of cases of plumbism.	Number examined.	Number of cases of plumbism.	Number examined.	Per cent plumbism.	Per cent plumbism.	Per cent plumbism.
Dipping-room......	17	107	21	185	45	268	15.9	11.4	16.8
Glost-kiln room.....	32	273	25	157	20	193	11.7	15.9	10.4
Glaze-mixing room..	2	11	2	11	10	21	18.2	18.2	47.6
Total.........	51	391	48	353	75	482	13.0	13.6	15.6

In the dipping room 17 cases of positive and presumptive lead poisoning are found out of a total of 107 persons examined where the amount of lead in the dust is found by our analysis to be less than 5 per cent. Twenty-one cases of positive and presumptive lead poisoning are found out of 185 examined in the dipping room where the per cent of lead in the dust samples varies between 5 and 10 per cent; and 45 cases of positive and presumptive lead poisoning are found out of 268 examinations where the dust in the dipping room has 10 per cent and over of lead. The corresponding rates of positive and presumptive plumbism are 15.9, 11.4, and 16.8 per cent. In the glost-kiln room these rates are 11.7, 15.9, and 10.4 per cent. In the glaze-mixing room they are 18.2, 18.2, and 47.6 per cent. This gives a total of 51 cases of positive and presumptive lead poisoning out of 391 examinations where there is a smaller amount of lead in the dust, 48 cases out of 353 of the next class, and 75 cases out of 482 examinations where there is a greater amount of lead in the dust. The rates of positive and presumptive plumbism for these three different amounts of lead in the dust are 13.0, 13.6, and 15.6 per cent, respectively.

While these rates may not increase in all rooms as the number of dust particles increases nor as the per cent of lead in the dust increases, partly on account of an insufficient number of cases and partly on account of other hygienic factors which we have not yet analyzed, yet the totals do. An attempt to analyze these various groups according to age, length of exposure, and occupation shows that they are about normal with the whole group, and therefore with each other, so that differences are not produced by these three factors. In those rooms where the dust count is less than 200,000 particles per cubic foot and where the per cent of soluble lead in the dust is less than 5, the rate of positive lead poisoning is about one-third as high as it is in the rooms where the dust count is over 500,000 particles and the per cent of soluble lead in the dust over 10. It is evident, therefore, that amount of dust and amount of soluble lead in the dust are contributing factors, and any attempt to eliminate dust should result finally in a reduced number of cases of lead poisoning. A more explicit statement and a further attempt to analyze results is reserved until we have made a study of the various other factors having to do with dustiness such as have been enumerated in the beginning of this section on "Plant hygiene."

WARE BOARDS.

We have already furnished information in regard to the cleanliness of ware boards as we found them during our survey. In some plants these boards are not cleaned and give rise to considerable dust when they become dry, so much that the workers complain about them. Table LVI, given below, shows the rates of plumbism according to cleanliness of the boards upon which the ware is carried from the dipping tubs.

TABLE LVI.—*Plumbism with respect to cleanliness of ware boards.*

Condition.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
					Positive.	Positive and presumptive.
Clean	45	41	90	673	5.3	10.1
Fair	5	6	3	79	5.4	11.8
Dirty	78	59	63	481	11.4	20.1
Total	128	106	156	1,233	7.9	14.4

Where the ware boards are kept reasonably clean, the rate of positive plumbism is 5.3 per cent; where the condition of the ware boards is fair, the rate of positive plumbism is 5.4; and where they are never cleaned or are dirty enough to be complained about, the rate of positive plumbism is 11.4. The positive and presumptive rates are 10.1, 11.8, and 20.1.

The groups included in Table LVI are analyzed carefully and are found to have a regular and normal distribution as far as age groups, periods of exposure, occupations, and sexes are concerned, so that these factors should not produce any variations in the rates given.

Again, we find higher rates where hygienic conditions are not observed. To just what extent dirty ware boards are responsible for higher rates is of course not possible to measure. Undue weight can not be given to this or to any other single factor as long as it is associated with other factors that can not entirely be eliminated from a partial share in the results. It is safe, however, to conclude that proper cleanliness would result in less dust and in fewer causes for high rates of plumbism.

SPLASH AND SPILL.

In some plants a noticeable amount of glaze is found to be splashed about the dipping tub during the process of dipping and during the process of filling the tubs with glaze. When the splash or spill of glaze is allowed to dry, it gives rise to considerable dust which affects possibly all dippers, dippers' helpers, and ware carriers. In plants where carelessness of this kind seems to prevail, the rate of positive plumbism is found to be 8.6, as opposed to a rate of 6.1 in plants where more care is observed. The positive and presumptive rates are 15.0 and 11.1. An analysis of these two groups shows that there are little differences as far as personal factors are concerned. The difference in rates is sufficient to classify splash and spill as contributing factors in plumbism.

DRY SWEEPING AND SWEEPING DURING WORKING HOURS.

In plants where dry sweeping seems to prevail and where the amount of water used is insufficient to lay the dust a rate of positive plumbism of 9.7 is found. In the other plants the rate of plumbism is 6.9. The positive and presumptive rates are 15.8 and 12.7 per cent. The two groups in these plants are about normal, with the exception that there are a large number of kiln men in the rooms where dry sweeping is practiced. As the rate of plumbism for this occupation is a little below that of all males examined, the elimination of this factor would tend to increase the rate of plumbism where dry sweeping is practiced. There is a smaller proportion of women in these plants, at least in the rooms where dry sweeping is done, sufficient to offset the occupational differences noted due to an excess of kiln placers.

In plants where sweeping is permitted during work hours the rate of plumbism is found to be 8.6, as opposed to 6.6 in those plants in which the time of sweeping is delayed until the workers have left the building. The positive and presumptive rates are 15.7 and 10.9. As women usually leave from a half hour to an hour earlier than the men, they are seldom present when sweeping is going on. Moreover, very few women are employed in the kiln rooms, where sweeping needs to be done during the work period, so that sex does not appear here as a factor. The age and exposure factors appear to be about the same in these two groups. The occupational differences are slight, with the exception that a few more kiln men work where sweeping is done during the work hours, which would tend to increase slightly the differences between the rates given for these two groups.

It thus appears that the method and the time of sweeping, where dust is involved, contribute toward an increase in lead poisoning. The exact effect is not of necessity shown by differences in rates, nor can we estimate with any degree of exactitude how much smaller the number of cases of lead poisoning would have been had the sweeping been done in a satisfactory way. We must content ourselves with saying that it would have been less.

ILLUMINATION AND VENTILATION.

We have already discussed the adequacy of these two factors in our description of plant conditions. Ventilation is included with dustiness, because by means of proper ventilation a great deal of the dusty air of the work rooms can be removed. Without adequate artificial ventilation dust remains in these rooms, to be stirred up day by day, so that the worker is continually breathing air in which dust has accumulated for some time. Illumination is included in connection with these other factors because poor illumination prevents the worker from seeing the dustiness of the air, so that he is not able to detect its presence because of poor lighting. Moreover, for a like reason, he is not able to judge when the room is clean. Approximately half of the employees work in poorly lighted rooms. The rate of positive plumbism among this group is 10.8. The positive and presumptive rate is 19.4. We find upon examination that the group is about normal with respect to age, length of exposure, occupation, and sex. About one-fourth of the whole group is working where the ventilation is unsatisfactory. The rate of plumbism in this group is 12.1. The positive and presumptive rate is 24.0. This group, upon examination, is found to be distributed normally among the various age groups, periods of exposure, occupations, and sexes. Where either or both of these factors exist, there are quite a number of the conditions referred to in this section under the head of "Dustiness," so that it is not possible to get a group of sufficient size where the illumination is bad and another of sufficient size where the illumination is good, but where the previously enumerated factors regarding the dustiness are alike. The same is true in getting together a group where ventilation is good and another where it is bad. There seems to be no doubt, however, that bad ventilation and poor illumination are factors needing attention if we wish to reduce plumbism.

OTHER DUST FACTORS.

The use of open glaze containers in the glaze-mixing rooms and the lack of respirators were taken up in combination with all dust factors, so that rates will not be given here showing plumbism for the presence or absence of these two items.

GENERAL SUMMARY REGARDING THE EFFECT OF DUSTINESS.

We have now analyzed for the effect of dust count and dust content, for conditions of ware board and for splash and spill, for dry sweeping, and for sweeping during work hours, and finally for bad ventilation and for poor illumination. It is difficult to evaluate each of the items mentioned above in order to determine its degree of responsibility in the group of similar factors of alleged influence in causing plumbism. However, all these present about the same series of increasing rates of lead poisoning as unsatisfactory and undesirable conditions prevail. It is logical to conclude that individual factors share in the results shown for the group as a whole and that each is entitled to a share of attention when corrective measures are under consideration.

As we have previously said, we would not presume to postulate that these differences which our figures show in rates of plumbism indicate definitely the effect of these various phases of air dustiness. It is not possible to refine rates to the point where we can say the elimination of a given factor will reduce plumbism by a definite amount. It is an unassailable conclusion, however, that an elimination of these unhygienic conditions will in time bring a reduction in the amount of plumbism and a reduction sufficient to make an attempt at hygienic conditions worth while.

PLAN FACILITIES FOR EMPLOYEES.

We have shown before the presence and absence of certain facilities which contribute toward the welfare of the worker. These include the supply of drinking water, the manner in which it is kept available, the drinking facility, the rooms and other facilities for eating lunches, the washing facilities, the use of soap and towel, instructions in regard to hazards, the use of special clothing, of lockers, and of bathing facilities. This section takes up the discussion of those items which have to do with the individual with respect to drinking, eating, and keeping clean. We shall furnish rates of plumbism with respect to this group of items, in an attempt to show, if possible, what may be considered as contributing toward a higher rate of lead poisoning among the workers.

In trying to get an estimate of the effect of the nine factors which have to do with facilities furnished at the plants for the welfare of the employees the same difficulties arise as in getting an estimate of the effect of the factors concerning dustiness. No plant is found in which all these facilities are present, and only one plant is found in which they are entirely lacking. If, however, we consider the facility for providing drinking water, the facility by which water reaches the individual, the lunch-room facility, and the washing facility as being the most prominent ones, we are able to get 17 plants in which these items are considered as reasonably satisfactory. In these plants 271 workers were examined, who agree with those examined in the other 75 plants, as far as sex and occupational distribution is concerned, but who are slightly underaged and about two years underexposed as compared with this larger group. The rate of positive plumbism where these facilities are good is 2.6, as compared with 8.7 for the other group. The positive and presumptive rates are 7.7 and 14.6. It should be recognized that these differences in the rate of plumbism are not to be charged entirely to the presence or absence of good facilities, because the factors enumerated under "dustiness" also enter here in such a way that an adjustment of rates can not be made which would eliminate all factors other than personal facilities.

This means, then, that differences in rates between these two groups may be charged partly to differences in lengths of exposure, partly to differences in the adequacy of personal facilities, partly to conditions of dustiness, and partly to toilet and sewer conditions, which latter effect will be discussed later. However, our series of rates is of significance, and it is to be realized that personal facilities are factors worthy of consideration in an attempt to reduce the presence of lead poisoning among pottery employees.

Again we take up the separate items in the group in order to discover whether each of the various plant facilities has a responsibility of its own in determining the amount of lead poisoning. A discussion of each separate facility follows.

WATER CONTAINERS.

A record was made of the sources of supply of drinking water. In most plants city water is available, but in a very few cases the water has to be carried from wells, which in some instances are situated on the property of the plant, and in others upon adjacent property.

Some differences are found in the rates of plumbism with respect to the kind of vessel in which the drinking water is kept. In some plants there are taps, so that it is not necessary to have water kept in any kind of vessel. In other plants water needs to be carried into the workrooms and is kept sometimes in open pails, at other times in closed pails or bottles, and occasionally in some kind of cooler. An attempt is made in Table LVII to show the frequency of lead poisoning with respect to the method of keeping drinking water available for the workers as far as pails are concerned.

TABLE LVII.—*Plumbism with respect to method of keeping drinking water.*

	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
					Positive.	Positive and presumptive.
Covered pails	13	1	15	116	9.0	9.7
Open pails	81	54	98	666	9.0	15.0

Where covered pails are used, the rate of positive and presumptive plumbism is 9.7 per cent; where open pails are used, the rate is considerably higher, being 15.0 per cent. The positive rates are each 9.0 per cent. Occasionally the plants have taps, also some covered pails and some open pails, so that it is not possible completely to separate the groups of workers according to the method of keeping drinking water available.

An analysis of these groups shows that they have about the normal sex distribution and about the normal age distribution. Those using open pails are slightly underexposed as far as years of exposure are concerned. Those using covered pails are about normal with respect to length of exposure and to occupation, although it should be noted that they are few. in numbers. With respect to occupation those in the group using open pails are distributed a little more heavily among the more hazardous occupations, about sufficient to balance the rate of exposure, so that the rate shown in Table XLII should be correct as far as these factors are concerned.

DRINKING CUPS.

An attempt, therefore, is made to show the rate of plumbism with respect to the types of drinking vessels. A very few plants furnish individual cups. In these the rate of positive plumbism is 7.4 per cent. Bubblers and other sanitary devices for drinking were found in a few places, in which the rate of positive plumbism is 6.0 per cent. In the majority of plants, however, involving over 80 per cent of the workers, common cups are in use, and in these plants the rate of positive plumbism is 7.9 per cent. Table LVIII shows these facts in a classified manner.

TABLE LVIII.—*Plumbism with respect to drinking facilities.*

	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
					Positive.	Positive and presumptive.
Individual cups	4	2	3	45	7.4	11.1
Bubblers, or fountains	11	2	11	160	6.0	7.1
Common cups	124	102	154	1,190	7.9	11.4
Total	139	106	168	1,396	7.7	13.5

Since most of the workers are included in the plants using common drinking cups the other groups are small, and it is difficult to analyze them with any degree of satisfaction. The few individuals comprising the small groups are distributed among such a variety of other factors that it is not possible to divide them in such a way that any good basis of comparison would result.

Again we wish to imply that differences in rates are not to be interpreted as chargeable entirely to drinking facility. Although the positive rate is 0.5 per cent higher and the positive and presumptive rate 3.3 per cent higher where common cups are in use, it is not to be presumed that their elimination would bring about a reduction in rates of plumbism by any amount shown in Table LVIII. There are other conditions of plant hygiene that need to be considered and which it may not be possible to eliminate so that the effect of a single factor may accurately be obtained.

LUNCH ROOMS.

We have already shown that about 1 plant in 12 has lunch-room facilities and that some of these rooms are poorly lighted and are not well cleaned, so that they may not be classed as good as far as usefulness is concerned. Some plants provide hot plates, so that the worker may have hot coffee, and this facility is frequently found upon his workbench. Thus while continuing his work he may have near at hand a hot drink, made perhaps in an open vessel, which he may drink from an open cup, into which dust can easily settle, so that with each drink he may be getting a small dose of lead. This facility, then, intended as a welfare provision may easily become a contributing factor toward lead poisoning.

We have shown previously the rate of plumbism for those who eat in the workrooms where lead is present. In a few instances eating in the workroom is forbidden by regulations, but frequently the regulations are not enforced. In some plants there seems to be no other place for the worker to eat, unless he takes the time to go home. The absence of proper lunch rooms no doubt brings about a great deal of the eating observed in the various workrooms of the plant. On account of the higher rate of plumbism noted among those who eat in the workrooms, it appears that absence of lunch rooms and eating places of proper type becomes a contributing factor to lead poisoning.

WASHING FACILITIES.

Investigation is made into the rates of plumbism for those plants having poor washing facilities and for those where the washing facilities seem to be satisfactory. In plants where the washing facilities are poor the rate of positive plumbism is found to be 8.7, while in the other plants it is 6.6. The positive and presumptive rates are 15.7 and 10.3. These two groups are about equal in size, each comprising approximately one-half of the total number of workers, with about the same sex distribution. There seem to be no marked differences in the occupational distribution, nor in that of age, nor in that of length of exposure. Those plants, however, which have poor washing facilities have also quite a number of other unhygienic conditions, so that as compared with those having better washing facilities the differences noted in the rates of plumbism given above can not all be charged to washing conditions. In addition to the poor facilities for washing there is usually a lack of soap and towels. In some plants the use of soap is not permitted in the facility furnished by the plant because the facilities are such that it is necessary to wash the hands in the same tubs where the ware boards are washed and because the glaze which settles in these tubs is collected and transferred to the dipping tub, to be used once more.

Further analysis of the group having poor washing facilities is impracticable because the hygienic conditions are so distributed that it is not possible to get two groups of plants similar in many respects, one group of which has good washing facilities and the other poor. It is perhaps sufficient to point out here that lack of proper washing facilities seems to assist in producing higher rates of plumbism.

OTHER PERSONAL FACILITIES.

Lack of special clothing for certain processes and lack of lockers and of bathing facilities prevail throughout most of the plants, but the lack is more generally noticed in those plants where the rate of plumbism is highest. Where special clothing is used, it is both necessary and possible for the worker to change from work clothes to street clothes at the end of the work period, for by so doing he does not carry a great amount of lead glaze and dust to his home. Where lockers are provided, it is possible to protect his street clothing from dust during the work period. Where lockers are of the double type, it is possible to keep street clothing in one section and work clothing in the other, and thus to take every precaution to keep street clothing clean and free from lead glaze. Where special clothing is furnished, with the double type of locker and in addition shower baths or some other bathing facilities, it is possible for the worker to leave the plant entirely clean and his dosage of lead ends when he leaves the plant. These facilities and combinations of facilities for cleanliness are so rare that the large majority of workers are compelled either to wear their work clothes to their homes or to change in the workroom, where their street clothing hangs all day and where their work clothing remains until the beginning of the next day's work. Lack of bathing facilities also renders the change of clothing less beneficial than it might otherwise be.

INSTRUCTIONS.

As we have pointed out before, instructions regarding the dangers of lead and the proper personal habits which should be observed and the other contributing factors that should be avoided are so seldom given in a methodical and effective way that the employees work under dangerous conditions because of either ignorance or unconcern. It seems to be taken for granted that the worker would either learn of the hazards from his fellow workmen or that he would not discover them at all. At any rate, lack of instruction seems to prevail where plant hygienic conditions are quite unsatisfactory and where rates of plumbism are high.

GENERAL SUMMARY OF THE EFFECT OF PLANT FACILITIES.

We now see why no item in the group of plant facilities can be discarded as having no responsibility in contributing toward higher rates of lead poisoning. It is not to be assumed that each item is to be considered as a contributing cause proportionate to the differences in rates shown between satisfactory and unsatisfactory conditions, but combined they show conditions that may certainly be responsible for lead poisoning. Objection may be raised that this difference in rates is a mere coincidence, and thus there might result a different interpretation. It is for this very reason that we analyze each group to find, if possible, whether differences in rates may be charged to other known factors. After elimination, or evaluation of these other factors, it is difficult to see where mere coincidence would enter often enough to reduce the reliability of our rates to any marked degree. Our attempt is always to discover contributing factors, if any exist, and then to point these out in such a way that other possible causes may not be overlooked, yet so to label those needing correction that factory workers and plant owners may be advised properly as to their hazardous effects.

As far as personal facilities are concerned, it is perhaps sufficient to note that facilities for eating, drinking, and keeping clean all show higher rates where conditions are not satisfactory, and they are therefore not free from responsibility as contributing factors; and that when unsatisfactory facilities are taken together there results an increase in the series of rates, as poor facilities become the rule rather than the exception. Our purpose in making rates for component parts and for the group as a whole is to strengthen the conclusion that such unhygienic conditions have an undoubted relation to the increase of lead poisoning in the plant.

TOILETS AND SEWERS.

Since constipation seems to be a prominent symptom of lead poisoning, it is suspected that toilet facilities and provisions for removal of toilet wastes need to be studied carefully in order to determine, if possible, whether conditions that promote the regular use of toilets have anything to do with the rates of plumbism found in this survey.

The majority of these potteries are situated in cities or near enough to the various city sewer systems to be connected with adequate methods of removing sewage. The number of employees in those plants not connected with sewer systems makes a comparison between plants having sewer systems and those having no systems rather unreliable.

Several conditions are necessary in order to define toilet conditions as good, fair, or bad. Among these are matters of sanitation, which have to do with cleanliness of the toilet rooms, good sewer connections, ample lighting, and proper ventilation. They need to be considered also as to whether they are adequate—that is, of a sanitary type—and whether there is a proper ratio of toilet facilities to the number of employees using them. Again there is the matter of availability, as to the distance of the toilet room from the worker, which is a point worth considering, as is the position of the room, especially with respect to whether it is on the same floor with the worker. It is also important to know whether the toilet building is outside so that the worker is exposed to the weather in going to and from such toilet. In other words, it is necessary to know whether the conditions of the toilets are such as to promote their regular use. If toilet rooms are unsanitary, poorly lighted, poorly ventilated, not flushed frequently; if the ratio of workers to each seat is too large; if these rooms are on the second floor or on the roof, as they sometimes are; if they are several hundred feet away from the usual position of the worker; if they are outside and the worker has to go out in all kinds of weather to reach them; or if there is no privacy about them, so that the seats are not in separate compartments;

such conditions, whether they exist singly or connectedly, do not promote a prompt and regular use by the pottery worker. This is especially true if he is working by the piece, and it is also true of the timeworker if his foreman works by the piece. All the above conditions were considered in deciding whether toilet conditions are good, fair, or bad, both by our workers in the field and by our own research workers in making up the following table:

TABLE LIX.—*Lead poisoning by diagnosis according to toilet conditions at plant.*

Condition.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
					Positive.	Positive and presumptive.
Good	17	13	44	434	3.5	5.9
Fair	37	18	36	331	8.8	13.0
Bad	85	75	88	631	9.7	18.2
Total	139	106	168	1,396	7.7	13.5

A study of this table shows us that where the toilet conditions are considered good the rate of positive plumbism is 3.5; where they are considered fair the rate is 8.8; while where toilet conditions are considered bad the rate is 9.7. The positive and presumptive rates are 5.9, 13.0, and 18.2. Combining good and fair toilets, we get a rate of 5.8 of positive plumbism and a rate of 9.1 of positive and presumptive, which rates are each about one-half of those for bad toilets. It should be stated also that frequently in a plant toilet conditions would be found good for some workers and bad for others, so that it is necessary to split up different groups of workers, either by sexes or occupations, as the case might be, in order to evaluate properly the results of toilet conditions.

An attempt is made to analyze the conditions affecting these two groups; namely, the group where the toilet conditions are considered bad and where the rate of positive plumbism is 9.7, and the group where the toilet conditions are considered reasonably satisfactory and where the rate of plumbism is 5.8. These groups are found to be about normal as far as sex and age distributions are concerned. In the matter of exposure the group using bad toilets is slightly underexposed as far as length of exposure is concerned and has slightly fewer occupational hazards, and therefore less intensity of exposure, although these two items are perhaps insufficient to add materially to the differences in the rates of plumbism.

It is hardly fair to charge the differences shown in Table LIX wholly to toilet conditions, because there are about the potteries so many other unhygienic conditions that contribute toward making up differences in rates of these two groups. Where bad toilet conditions are found, there are often some of the other contributing factors which we have already analyzed, so that even after the elimination or the evaluation of these other factors it is not possible to refine our rates to the point where we are able to say that elimination of bad toilets will decrease plumbism to the rates shown for good toilets, However, although we are not able to estimate the extent of such reduction, we are warranted in drawing a conclusion, which seems unassailable, that a reduction will occur in due time. The nearest approach we can get to the effect of bad toilets (to the exclusion of all other factors) is to group together as many plants as possible where other hygienic conditions are equal, one part of which group has good toilets and the other part bad toilets. When that is done. rates continue to be from two to three times as high for bad toilets as for good ones, as is shown in the discussion which follows. Our discussion in this paragraph is intended merely to caution the plant owner not to get the impression that merely overhauling or rebuilding the toilets about the plant and putting them in a condition that will promote their use would cut the rate of lead poisoning to one-half or one-third the former amount. We wish to show, since we find it to be true, that bad toilet conditions are factors which demand attention, and to impress our firm belief that if proper toilet facilities are furnished by the plants and if the workers will give due attention to the use and care of such toilets, one of the chief contributing factors of lead poisoning will be eliminated, and reduced rates of plumbism will result.

Twenty-eight plants are found in which the dustiness is considered to be the same throughout, if we take into consideration the chief factors producing dust—namely, dirty ware boards, dry sweeping, sweeping during work hours, splash and spill, and dust count. Fifteen of these plants have bad toilets. In the 15 plants having bad toilets the sex distribution, length of exposure, and distribution of employees among the various occupations are about normal. In these plants 229 people have a rate of positive plumbism of 8.7 and a rate of 14.4 for positive and presumptive plumbism. In the 13 plants where toilets are good the sex and age distribution are about normal. They are underexposed as far as length of exposure is concerned, but overexposed as far as distribution among the various occupations is concerned, these two factors about balancing each other; 203 persons have a rate of 1.9 for positive plumbism and of 3.9 for positive and presumptive plumbism.

Thirty-six plants are found where the personal facilities seem to be about equal throughout, if we consider the more important factors of places to eat, drinking-water systems, and washing facilities. Fifteen of these plants have bad toilets, and 21 of them have satisfactory toilets. In the 15 plants having bad toilets the sex, age, exposure, and occupational distribution is approximately normal with the whole group of workers examined. The rate of positive plumbism of the 328 persons examined here is 9.4, while the positive and presumptive rate is 19.0. In the 21 plants having good toilet systems the sex and age distributions are about normal. The workers are, however, slightly underexposed, but in slightly more hazardous occupations, the differences about balancing each other. The rate of positive plumbism of these 368 employees is 4.6 and that of positive and presumptive plumbism is 8.9.

In the above analysis we have in the one case eliminated as far as possible dust conditions, and in the other we have eliminated as far as practical the effect of absence of proper personal facilities, in which case the rate of positive plumbism for those groups having bad toilets is about 9 per cent, or a little less than that for all plants where bad toilets are found. Among these two groups where toilet conditions are considered good the rates are somewhat lower than they are in all the plants having good toilet conditions.

An attempt is made to analyze the situation further by selecting as many plants as possible where both the conditions of dustiness and the personal facilities are about equal. Eight such plants are found, four of which have bad toilets. The real test of the effect of bad toilets should be shown in an examination of groups of this kind; that is, in groups where plants are alike with the exception of the toilet conditions. It is not possible to find a group sufficiently large to make these rates reliable. The figures are given, however, as worthy of consideration.

In the four plants having bad toilets the age, sex, and exposure distribution is about normal for the whole group of workers. They are distributed in the occupations so that a slightly lower expected rate of plumbism would result because of occupation. The 40 persons examined in these four plants have a rate of positive plumbism of 15.0 and a positive and presumptive rate of 32.5.

Those examined in the four plants where toilet conditions are considered good have about normal sex, age, and occupational distribution. They are, however, about three years underexposed, sufficiently to cause a slight change in the expected rate of plumbism for the group. These 46 people have a rate of positive plumbism of 4.3 and positive and presumptive rate of 8.7. If we adjust this rate for underexposure, it would be perhaps 1 per cent higher. It will be noted here that the rate of plumbism where toilets are bad is about three times as high as the corrected rate of plumbism where toilet conditions are considered good, in these eight plants where other factors have practically been eliminated. It should be observed, however, that the small number of plants and the small number of those examined make these rates unreliable for close comparison, and they should be kept in mind only for the purpose of noting that where bad toilets exist the rate of plumbism is higher than where better conditions are found, and that these rates are sufficiently consistent to help us reach a conclusion warranted only by considering the previous analysis.

In summarizing this analysis it should be kept in mind that while the personal factors are somewhat consistent throughout the various groups that are being compared the total differences between the rates in each case may not properly be charged entirely to toilet conditions, because of the impossibility of eliminating the other unhygienic conditions about the factory without reducing numbers down to a point where rates would be meaningless. However, sufficient analysis has been given here to show that bad toilet conditions are without doubt contributing factors in producing plumbism and that careful consideration ought to be given by plant proprietors to this contributing factor. After discussing certain hazards found in our survey of the potteries we will include toilet conditions with all other bad hygienic conditions about the plant for the purpose of finding rates of plumbism with reference to the number of unhygienic conditions found in these various plants.

OTHER HAZARDS.

Besides these various hygienic conditions already discussed there are certain other factors which we found during the course of our survey. Certain plants have a heat hazard, or perhaps a fatigue hazard, or a cold hazard, or a wet hazard. In nearly every plant some one of these conditions is found, although not always in a pronounced degree.

The heavy work in connection with kiln placing, which involves carrying as much as 85 pounds of ware upon the head, climbing a ladder, and placing this material at the top of a kiln, is usually fatiguing. The monotonous work of brushing, cleaning, and fettling has in it the elements of fatigue. In certain plants there is a continual splash about the dipping tub, so that the dippers and helpers frequently stand in damp or wet places during the course of the day. There are certain processes in connection with the emptying of kilns and in the sifting of glaze upon heated ware which might be styled a heat hazard. Upon occasions we find poorly heated buildings and workers exposed to draft after heated operations, such that a cold hazard may result. However, in our discussion in this part of the survey we have included only the pronounced hazards. In four plants having a pronounced heat hazard, employing 175 people, a rate of positive plumbism of 12.0 is found. In analyzing the conditions of this group of male workers and comparing them with that found in the plants as a whole, we find that they are about normal as far as age distribution is concerned, that they are about three years underexposed, and that they are in slightly more hazardous occupations, as a larger number of them are dippers, or enamelers as they are sometimes called. These factors perhaps offset each other, so that our rate of plumbism would not be changed materially in this group.

Four plants are found in which there is a pronounced cold hazard. Eighty-two people employed in these plants have a rate of positive plumbism of 17.1. The sex distribution and the occupational distribution are about even. The workers are, however, about two years overexposed, but not sufficiently to call for this exceedingly high rate of plumbism. However, the high rate is no doubt affected by other unhygienic conditions about the plant, as each of the plants included above has a large number of unhygienic conditions.

Four plants are found where a pronounced wet hazard exists. The 55 people examined in these plants have a rate of positive plumbism of 21.8. The sex and occupational distribution are found to be about normal, although the workers are about two years overexposed and are working under a very high number of other unhygienic conditions.

It is not possible to eliminate the other factors in a satisfactory way without reducing the groups down to numbers insufficient to make rates comparable and reliable.

In investigating the fatigue hazard we find a rather large group working under conditions which were enumerated by our investigators as being hazardous. The rate of positive plumbism for this group is 10.9, which rate is not affected by sex, length of exposure, nor occupational distribution. It is found, however, that those included in these fatiguing processes are working in plants where a large number of plant hygienic conditions are unsatisfactory. Therefore, the high rate for this group is probably largely attributable to these other factors. In connection with the study of fatigue we should, perhaps, call attention to our reference to piecework made earlier in this section. A further analysis of the fatigue hazard, as well as of the others included above, will be made in a final summary of plant conditions.

SPECIAL PROCESSES.

In 11 of the plants surveyed our investigation deals with some special processes, such as machine dipping, use of tunnel kilns, spraying of either liquid or dry glaze on cold or hot ware, addition of glue or gelatin to glazes, and painting the glaze on the ware by using a hand brush.

Table LX shows the number of these plants, with the various special processes and the rate of plumbism for each process and the rate of plumbism for the persons examined in these plants. Table

LXI shows the number of plants employing these various special processes and the rate of plumbism for persons occupied only in that part of the plant using such processes.

Table LX.—*Number of plants and kind of special processes and rate of plumbism for all workers examined.*

Number of plants.	Kind of special processes.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
						Positive.	Positive and presumptive.
3	With automatic dipping machine	1	0	0	24	3.8	3.8
4	With continuous kiln	1	2	1	41	2.2	6.7
2	Glaze sprayed or sifted on hot ware	11	2	7	76	11.5	13.5
2	Air spray painted or machine sponge	....	1	2	33	0.0	2.8
2	Glue in glaze, painted on ware	....	....	2	13	0.0	0.0

Table LXI.—*Number of plants and kind of special processes and rate of plumbism for special occupation.*

Number of plants.	Kind of special processes.	Occupation.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
							Positive.	Positive and presumptive.
3	With automatic dipping machine.	Dippers	....	....	1	14	0.0	0.0
4	With continuous kilns	Kiln men.	....	1	0	4	0.0	20.0
2	Glaze sprayed or sifted on hot ware.	Dippers	7	0	4	56	10.4	10.4
2	.....do	Kiln men.	2	0	0	2	50.0	50.0
2	Air spray painted or machine sponge.	Dippers	....	....	2	17	0.0	0.0
2	Glue in glaze, painted on ware	...do	....	....	0	3	0.0	0.0

Although in most of the special processes there is not a sufficient number of persons employed to make the results as reliable as we might desire, yet the tables show us that in plants having automatic dipping machines the rate of positive plumbism for all workers is 3.8 and for the dippers operating these machines it is 0.0. In the four plants having continuous tunnel kilns the rate of positive plumbism for all employees is 2.2.

There are two plants which spray a base coat with a liquid glaze, by the use of an air compressor, and then afterwards sift dry glaze on the hot ware after it has been withdrawn from the kiln. It will be noted that the rate of positive plumbism for all workers in these two plants is 11.5, while for dippers, or enamelers as they are called, in these plants the positive rate is 10.4. Of the four kiln men examined in these plants, two, or half of those examined, are found to have positive lead poisoning. Two plants are found in which an air spray is used in putting on a base coat and in which the other coats are either painted on or applied by machine sponging. In these plants the positive rate for all workers is 0.0, and for all dippers is 0.0. Two plants are found which use glue or gelatin in the glaze, in an attempt to avoid dust in the dry glaze, and in which ware is painted with this pasty mass by use of a hand brush. The tables show that the rate of plumbism in these two plants is 0.0, and for the dippers employed therein is 0.0.

SUMMARY OF PLANT CONDITIONS.

We have now seen the probable relationship between certain groups of working conditions and plumbism. Thus in our analysis of air dustiness a ratio was approximated between good and bad conditions of ware boards, between dry sweeping and wet or watered sweeping, between plants with a high dust count and those with a lower dust count, and finally for such combinations of dusty conditions as it is possible to make. In like manner we have shown rates for different conditions of personal-service facilities and for groups of facilities. We have shown rates where bad toilet conditions seem to predominate and rates where good conditions are found. We have shown rates where certain other hazards exist. In each case an attempt has been made to evaluate for such personal factors as age, sex, length of exposure, and occupation, and to eliminate as far as possible the effects of other unhygienic conditions. As pointed out before, it is not to be assumed that these rates are refined to the point of giving an accurate relationship between these alleged contributory causes and the rates of plumbism found in the various plants. The probability is, however, that they point with sufficient clearness to such conditions as causative factors, to show that in any program for elimination of plumbism where lead is retained as a component part of the glaze such factors must of themselves be brought up to standard requirements essential to the maintenance of plant hygiene.

We repeat that in analysis of good and bad conditions which might have a relationship to the incidence of lead poisoning the factors responsible in part for plumbism have not necessarily been exhausted. There are unrelated factors, some of which we have noted and some of which we may have overlooked. Some of these are immune from analysis, perhaps, because difficult to measure or detect and unrelated to other factors capable of being grouped. It has always been our purpose, however, to analyze and evaluate or eliminate when possible, so that the effect of a single factor may be as clear as it is possible to make it. Plant conditions do not lend themselves as readily to evaluation as do personal factors, because of certain difficulties in measurement.

In the pages that follow an attempt is made to correlate as many of these salient features as possible and to show their combined effects. Thus, air dustiness, personal-service facilities, toilet conditions, and certain hazards are combined, as well as eliminated and evaluated, for the purpose of showing rates for combinations of conditions and of assisting in placing responsibility for high rates of plumbism upon plant sanitation, so that neither plant managers nor plant employees may shirk their respective responsibilities in furnishing sanitary conditions and in keeping and observing hygienic regulations. Our explanations are given in detail, so that the reader will not jump at the conclusion that to mend a given condition will bring an immediate and definite reduction in plumbism. Our rates, then, are only danger signals that are entitled to careful consideration, and should be given sufficient heed if the dangers arising from the use of lead are to be overcome. The whole purpose of our study will be defeated if snap judgments are formed without due consideration and without a careful reading of all we have to say regarding the causative factors of plumbism. We ask the reader to use the same statistical caution and studious care in reading this report that we have in assembling the facts and in analyzing them.

Table LXII gives a summary of several of the related conditions previously mentioned and of some others enumerated under Appendix D.

TABLE LXII.—*Plumbism according to conditions at plant.*

Condition.	Positive.	Presumptive.	Suggestive.	Negative.	Rate of plumbism.	
					Positive.	Positive and presumptive.
With common drinking cup	124	102	154	1,191	7.9	14.4
Without common drinking cup	15	4	14	205	6.1	7.9
With bad toilets	85	75	88	631	9.7	18.2
Without bad toilets	54	31	80	765	5.8	9.1
With common drinking cup and bad toilet	82	74	87	595	9.8	18.6
Without common drinking cup and bad toilet	57	32	81	798	5.9	9.2
With open water pail	81	54	98	666	9.0	15.0
With covered water pail	13	1	15	116	8.9	9.6
With (a) common drinking cup, (b) bad toilet, and (c) open water pail	51	44	50	364	10.0	18.7
Without all of (a), (b), and (c) above	88	62	116	1,032	6.8	11.6
With (d) poor illumination	103	82	90	680	10.8	19.4
Without (d) poor illumination	36	24	78	716	4.2	7.0
With (a), (b), (c), and (d) above	46	31	33	209	14.4	24.1
Without all of (a), (b), (c), and (d) above	93	75	135	1,187	6.2	11.8
With (e) dirty ware board	78	59	63	481	11.4	20.1
Without (e) dirty ware board	61	47	105	915	5.4	9.6
With (a), (b), (c), (d), and (e) above	39	28	21	132	17.7	30.5
Without all of (a), (b), (c), (d), and (e) above	100	78	147	1,264	6.3	11.2
Without any of (a), (b), (c), (d), and (e) above	3	1	7	112	2.4	3.2
With (f) bad ventilation	46	45	40	248	12.1	24.0
Without (f) bad ventilation	93	61	128	1,148	6.5	10.8
With (a), (b), (c), (d), (e), and (f) above	18	17	7	52	19.2	37.3
Without all of (a), (b), (c), (d), (e), and (f) above	121	89	161	1,344	7.0	12.2
Without any of (a), (b), (c), (d), (e), and (f) above	3	1	7	112	2.4	3.2
With 16 and over bad conditions	57	41	37	212	16.4	28.2
With from 11 to 15 bad conditions	77	61	107	831	7.2	13.0
With from 0 to 10 bad conditions	5	4	24	354	1.3	2.3

In addition to the facts already noted, it will be observed that plants having combinations of certain bad conditions have also higher rates of plumbism. Plants having both common drinking cups and bad toilet conditions have a rate of positive plumbism of 9.8, as compared with a rate of 5.9 for other plants. Plants having open water pails in addition to these two conditions have a rate of positive plumbism of 10.0, as opposed to 6.8 for plants without these three conditions. Plants where the illumination is considered poor have a rate of positive plumbism of 10.8, as opposed to a rate of 4.2 for those where the illumination is considered adequate. Plants having all four of the bad conditions named above have a rate of positive plumbism of 14.4, as compared with the rate of 6.2 for plants not having all four of these conditions. Plants having dirty ware boards in addition to these four bad conditions have a rate of positive plumbism of 17.7, while plants with some but not all of these five conditions have a rate of plumbism of 6.3, and plants without any of these five bad conditions have a rate of 2.4. Plants having bad ventilation have a rate of positive plumbism of 12.1, as compared with the rate of 6.5 for those where the ventilation is considered adequate. Plants with all six of these bad conditions have a rate of positive plumbism of 19.2; those plants with some but not all of the six have a rate of 7.0; and plants without any of these six conditions have a rate of positive plumbism of 2.4.

Plants having 16 and more of the bad hygienic conditions noted in Appendix D have a rate of positive plumbism of 16.4. Those having from 11 to 15 of the bad conditions have a rate of positive plumbism of 5.3, and those having 10 or less of these conditions have a rate of positive plumbism of 1.3. The corresponding positive and presumptive rates are 28.2, 13.0, and 2.3 per cent.

In Appendix D an array is made of the 92 plants, from that with the highest rate of plumbism down to that with the lowest.

This varies from 37.1 per cent of positive plumbism and 71.4 of positive and presumptive plumbism to no plumbism of any kind. These 92 plants are then divided into three groups, about equal in size. Speaking specifically, there are 31 plants in the upper group, 30 in the middle group, and 31 in the lower group. The unhygienic conditions already mentioned, and some others—a total of 26—are included in this table. If a plant has one of these conditions, a star appears opposite the plant in question. For example, the plant at the top of the list, with the highest rate of plumbism, has 25 stars, which indicate that 25 out of 26 conditions are found in this plant. The plant at the bottom of the list, with 0.0 rate of plumbism, has 10 such conditions. Plants are found with as few as two of these conditions, noted in Appendix D.

Table LXIII shows a summary of the conditions existing in the three groups outlined above. In the 31 plants having the highest rate of plumbism the average length of exposure of the workers is 12.6 years, the average per cent of soluble lead in the glaze is 14.5, the rate of positive and presumptive plumbism for the group of workers examined in this group is 27.6, and the plants have on an average 15 of these bad conditions. In the middle group workers were exposed for an average length of 11.0 years, the average per cent of soluble lead used in the glaze is 14.1, and the rate of positive and presumptive plumbism for the group of workers is 8.3, this group having an average of 12 of the bad conditions. In the lower group the average length of exposure is 9.3 years, the average per cent of soluble lead used in the glaze is 12.7, the rate of positive and presumptive plumbism 0.0, and the average number of bad conditions in these 31 plants is 9.6.

These groups are similar as far as occupational distribution is concerned. The upper group averages about two years older than the group as a whole. The lower group is underaged by about the same amount.

TABLE LXIII.—*Summary of the three plant groups as given in Appendix D.*

Group.	Number of plants.	Average size.	Length of exposure.	Per cent of soluble lead in glaze.	Average of number of bad conditions.	Rate of positive and presumptive plumbism.
Upper one-third	31	221	12.6	14.4	15.1	27.6
Middle one-third	30	180	11.0	14.1	11.8	8.3
Lower one-third	31	134	9.3	12.7	9.6	0.0

In Table LXIV an attempt is made to split each of these groups into two, making a total of six groups arrayed according to the rate of plumbism.

TABLE LXIV.—*Rates of plumbism and average number of bad plant conditions when plants in Appendix D are divided into six groups.*

Group.	Number of plants.	Rate of positive and presumptive plumbism.	Average number of bad conditions.
Upper one-sixth	15	37.8	16.7
Fifth one-sixth	16	21.0	13.6
Fourth one-sixth	15	11.9	12.2
Third one-sixth	15	3.8	11.3
Second one-sixth	16	0.0	10.3
Lower one-sixth	15	0.0	8.3

In this table it is noted that the upper group of 15 plants, with a rate of plumbism of 37.8, has an average of approximately 17 of the plant conditions given in Appendix D. The next group, with a rate of positive and presumptive plumbism of 21.0, has an average of about 14 of these bad conditions; the next lower group, with a rate of positive and presumptive plumbism of 11.9, has an average of 12 such conditions; the next lower group, with a rate of positive and presumptive plumbism of 3.8, has an average of approximately 11 of these bad conditions; and the next two lower groups, with a rate of plumbism of 0.0 per cent, has 10 in the one case and 8 in the other of the bad conditions mentioned in Appendix D.

The Pearson coefficient[1] between the rate of positive and presumptive plumbism of these 92 plants as shown in Appendix D, and the number of bad hygienic conditions as shown in this same table is found to be 0.666. This signifies that where the rate of plumbism is high the chance that the number of bad conditions will be high also is about two out of three.

Chart 8 shows in graphical form the relation mentioned in this last paragraph—namely, that between the rate of lead poisoning in these 92 plants and the number of unhygienic conditions with which the workers must come in contact. The plants are arrayed so that the plant having the highest rate of positive and presumptive plumbism is at the left of the figure and those with a 0.0 rate are at the right. No smoothing is employed in the curve which shows the rate of plumbism.

It should be noted that these plants are arrayed in order of rate of positive and presumptive plumbism, except that the plants with the 0.0 rate of plumbism are arrayed in order of number of unhygienic conditions. The curve showing the number of unhygienic conditions is smoothed by a moving average. A study of figure 8 shows that these curves follow each other rather closely and strengthen the significance of the Pearson coefficient, 0.666, in placing a large responsibility upon plant conditions for the causes of lead poisoning found in the survey.

A COMPARISON OF THIS INVESTIGATION WITH THE FORMER SURVEYS.

In a previous chapter we have called attention to the surveys made by Hamilton and by Hayhurst and others. Doubtless there are those who will want to compare the results obtained to determine whether as time passes, improvements have resulted in working conditions, and the lead hazards of the industry have been made less injurious to the workers. Such a comparison can hardly be made, because of the differences in the manner of making the surveys. While these studies are all rather recent, they are separated by sufficient time so that no investigation enroached upon the plan of the other. The investigation conducted by Dr. Hamilton is a period investigation, and the cases of lead poisoning which she reports are those developing in the years 1910 and 1911. Her cases of plumbism, it would seem, represent the cases of lead colic and attacks of lead poisoning, and her rates no doubt indicate attack rates. The investigation conducted by Dr. Hayhurst is a status investigation and shows the conditions he found in existence in the plants at the time of his investigation.

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[1] Perfect correlation according to the Pearson coefficient is 1.000.

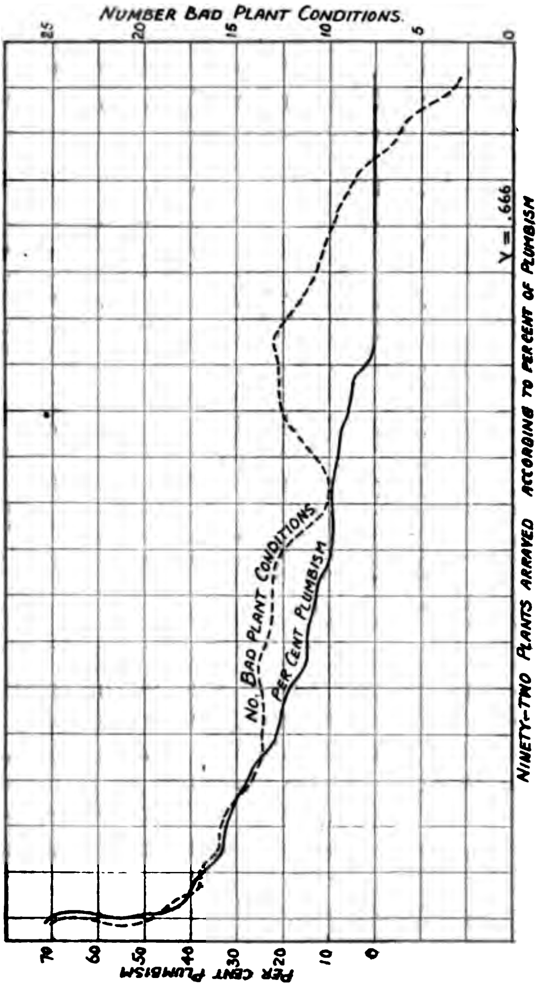

CHART 8.—Comparison of per cent of plumbism in potteries with number of bad plant conditions.

Our investigation is also a status study and shows just what we found among the potters of the 92 plants which came under our study.

In Dr. Hamilton's study, perhaps relatively few of the lead cases came under her direct observation, since she obtained information concerning the larger part of her cases from local physicians.[2] Others were obtained from hospital records, through personal questioning and examination, from reports of fellow workers, and a few, from certain labor organizations.[3] There is no record in her survey of the exact number of physical examinations made, nor of the manner of making an examination; nor of the exact diagnosis for lead poisoning. In Dr. Hayhurst's study it seems that the greater number of cases reported by him were found by direct physical examination, although some of the cases included were reported to him and were diagnosed as lead poisoning upon hearsay evidence. In our study every case of lead poisoning which we report was found by a careful physical examination and by a careful diagnosis. Table LXV shows in detail the differences of these three investigations.

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[2] Bulletin of the U. S. Bureau of Labor No. 104, p. 42.

TABLE LXV.—*Scope of each survey.*

	Hamilton.	Hayhurst.	Present study.
Date	1911-12	1914	1919-20.
Kind	Period	Status	Status.
Location	9 States	Ohio	New Jersey, Ohio, Pennsylvania, West Virginia.
Number of plants	68	47	92.
Number of employees.	No record	8,146	17,297.
Number exposed	2,505	2,585	1,902.
Number examined	No record	No record	1,809.
Number of cases reported.	179 in 1910 331 in 1911	Found and reported, 109	Found, 270.
Rate	1910, 7.2 1911, 13.2	4.2	15.0.
Directed by	Labor Department	Ohio State Board of Health.	United States Public Health Service.
Sources	Reports from: (1) Physicians, (2) hospital records, (3) questioning and examinations, (4) reports from fellow workers, and (5) labor unions.	Physical examinations and by reported cases not observed.	Physical examinations.

It should, perhaps, be pointed out that of the total 17,297 employees we found 1,902 engaged in occupations where they are exposed to a lead hazard, while in Dr. Hayhurst's study out of 8,146 persons employed in the 47 plants under discussion as many as 2,585 are stated to be exposed to a lead hazard. In other words, we find 11 per cent of the pottery employees exposed to lead hazards, while Dr. Hayhurst found approximately 32 per cent exposed. Of these, 1,902, we examined 1,809, or 95 per cent, of those exposed. We did not willfully fail to examine any exposed person. We found 139 cases of positive lead poisoning among the 1,809 persons examined, or 7.7 per cent of those examined were found to be suffering from positive plumbism. Our positive and presumptive rate is 13.5. Dr. Hayhurst found only 109 out of 2,585, or 4.2 per cent, of those examined and reported upon. In the absence of any diagnosis we do not know what he includes. It seems to us that he has included an oversized number of employees in order to get 2,585 exposed persons. If we take our rate of 11 per cent of his total number employed, 8,146, his 109 cases would give a rate of plumbism of 12.2. This differs by a less amount from our positive and presumptive rate of 13.5. This difference, however, might be explained because of a difference in diagnosis or because of a different distribution among occupations or sexes, or because of a difference in the selection of plants, or because of his large list of decorators. In other words, a different set of samplings might be expected to effect, in a small way, some differences in the results of these investigations.

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[3] Bulletin of the U. S. Bureau of Labor No. 104, p. 8.

It is difficult to make a comparison between our rates of plumbism and the rates found by Dr. Hamilton, on account of the differences which we have pointed out in the manner of making these surveys. Table LXVI gives in more detail the differences in the results of these investigations. In this table we have made a comparison by age distribution, by length of exposure, and by occupation. We have no data showing sex distribution of either of the two earlier studies.

TABLE LXVI.—*Results of each survey.*

	Hamilton.			Hayhurst.			Present study.		
	Reported.	Lead cases.	Rate.	Examined and reported.	Lead cases.	Rate.	Examined	Positive lead cases.	Rate.
AGE (YEARS).									
Under 20				75	5	6.7	218	2	0.9
20–39				2,035	66	3.2	355	44	5.1
40–44				324	19	5.9	235	28	11.9
45–49				78	8	10.3	173	18	10.4
50				55	11	20.0	328	47	14.3
Total				2,585	109	4.2	1,809	139	7.7
EXPOSURE (YEARS).									
0–0.9		38			6		239	3	1.0
1–4.9		36			35		392	17	4.3
5–9.9		63			25		294	19	6.5
10 plus		49			43		720	93	12.9
Total		186			109	4.2	1,695	132	7.8
OCCUPATION.									
Glaze mixer				51	9	17.7	112	11	9.8
Dipper	365	92	25.2	245	31	12.7	292	46	15.8
Dippers' helper	221	27	12.2	205	19	9.3	220	10	4.5
Ware cleaner				311	2	.6	104	3	2.9
Glost-kiln placer	464	19	4.1	474	36	7.6	707	49	7.0
Sagger washer				45	4	8.9	73	3	4.1
Decorator	20	3	15.0	1,217	7	.6	32	3	9.4
Other				37	1	2.7	269	17	6.3
Total	1,070	141	13.2	2,585	109	4.2	1,809	139	7.7

In Dr. Hamilton's study no full record is given of the age distribution of those coming under her investigation. The figures furnished here from Dr. Hayhurst are taken from the Ohio Public Health Journal of October, 1919. Our age groups are made to conform in class interval to those of Dr. Hayhurst. Perhaps we should point out that there is included here in the 20–30 age period about four-fifths of all the workers included in the Hayhurst study. Both distributions, however, agree in the gradually increasing rate of plumbism, as the age of the worker advances. Under length of exposure neither the Hamilton nor the Hayhurst studies show the rates for the various periods of exposure. Under the occupational distribution it should be observed that almost half of the Hayhurst cases are decorators, among whom he found an extremely low rate of plumbism—only 0.6 per cent. In our survey we are unable to find that the colors used in decorating contain a great amount of lead, or at least of soluble lead compound. The colors are generally mixed with oil, and most decorators do not come in contact with the lead used in glazing. There is seldom any tinting or ground laying in lead. We therefore examined only such decorators as seem to come in contact with the lead used in the glaze.

The Hayhurst rate is less than that found in our study. His rate for dippers' helpers is over twice as high as ours, while for glost-kiln placers it is about the same as ours. The rate for sagger washers is double ours. The rates found by Dr. Hamilton, 25.2 for enamelers and millworkers and dippers, 12.2 for dippers' helpers, and 15.0 for decorators, are all higher than ours; however, as pointed out before, it is difficult to make a comparison between these two studies, on account of the different ways in which these investigations were made.

In making the above comparisons we have not attempted to find fault with the manner of conducting these former surveys nor with the results obtained by them, but we have tried to point out the essential differences in the manner and method of conducting these investigations, so that anyone interested in making a comparison of the results of the three studies will have before him the reasons why a close comparison of the rates can not be made.

GENERAL SUMMARY.

It has been shown how these cases of lead poisoning are distributed among the various occupations of the pottery; how they are distributed among the various types of wares manufactured by the pottery establishment, and how they are distributed among the various plants with respect to the various amounts of soluble lead used in their glazes. The distribution of plumbism has also been shown according to various unhygienic conditions found in the plant, and it has been pointed out how these conditions, without doubt, are factors fostering plumbism. We have pointed out how certain personal habits, including eating and drinking, have affected the rate of plumbism among pottery employees. We are not able to charge any given per cent of lead poisoning or of the causes of lead poisoning to the plants and to plant conditions and the remaining per cent to the personal habits of the employees. We are not willing to say that one contributes more toward the incidence of lead poisoning than does the other. The recommendations to be made will affect both the employer and the employee.

Incidental remarks have been made concerning the responsibility of keeping the plants clean and of having certain sanitary conditions about the plants in operation. It seems to the investigators that under the prevailing system of piecework the responsibility for these matters is not definitely placed. The dipper, for example, is somewhat interested in turning out as many pieces as possible of dipped ware. The size of the output is the basis upon which he is paid. He receives pay from which he in turn pays his helpers. His department represents in a way an independent organization within the pottery institution. Likewise the kiln-placing and certain other operations as well are conducted rather independently of each other. The cleanliness of the rooms and the time of cleaning them in some instances may be charged to employees, rather than to the plant management. Each foreman, while in a way responsible for his special room or department, may not be especially interested in certain hygienic conditions which our survey shows to be of importance. A definite placement of responsibility ought then to be determined upon both by the plant owners and by the employees as to the matter of placing and keeping the pottery establishment in hygienic condition.

In this connection it might be pointed out that very little instruction is given to the pottery worker concerning the hazards in which he works and concerning the habits that he should form and the precautions which he should observe in handling lead glaze. In fact, it seems to the investigators that those in charge of the plants are either indifferent, or careless, or ignorant in regard to lead hazards. In reply to our inquiries a few of the plants denied having any lead hazards and denied having any cases of lead poisoning among their workers. For example, one plant says: "We use no soluble lead." In later correspondence this same plant says: "We use about 23 per cent of white lead." Our analysis of the glaze from this plant shows a content of 22.64 per cent of total lead and of 21.77 per cent of soluble lead. This plant also had one case of presumptive plumbism. In several of the other plants cases of lead poisoning were found where the existence of cases had been denied. One plant said that we would find that "the supposed cases of lead poisoning in potteries is rather a sort of myth." Four cases of positive lead poisoning were found among the employees of this firm. However, whatever may be the attitude of the plant managers and of the workers, we have furnished information concerning the hazards of lead and the conditions that foster lead poisoning. Sufficient cases have been diagnosed and sufficient data have been collected regarding plant conditions and concerning the habits of workers to warrant us in making certain definite recommendations, which, if carried out, should tend to reduce the possibilities of lead poisoning to a minimum.

PART V.

MEANS AND METHODS OF REDUCING THE HAZARD OF LEAD IN THE POTTERY INDUSTRY.

In this research in the pottery occupations certain factors have been shown which should be considered in the light of their effect in inducing lead poisoning among workers in certain processes where lead is used. It has been difficult to place the responsibility for these conditions, nor is it deemed best for us to try to place it. We are more interested in calling attention to the hazards present and in pointing out preventive measures for the elimination or control of these hazards.

If lead is used, certain precautions must be observed.

The worker who is really anxious to protect himself should heed the following advice:

INDIVIDUAL MEANS AND METHODS.

FOOD.

1. Always eat a good breakfast before going to work. Drink plenty of milk. The presence of food in the stomach helps to prevent the lead from getting into the system.
2. Take a lunch or drink milk in the middle of the forenoon and in the middle of the afternoon.
3. Never eat or drink in the workroom.
4. Do not keep drinking water in uncovered vessels in the workroom. (If you drink from such vessels you drink diluted glaze.)

CLOTHING.

1. Never wear street clothes nor street shoes in the workroom; keep them in closed, ventilated, individual lockers in some other part of the building.
2. Never keep work clothes in lockers used for street clothes. Never wear work clothes to your home; you expose your family to lead poisoning by doing so.
3. If you work in dust, wear a respirator.

CLEANLINESS.

1. Do not chew tobacco or gum while at work.
2. Do not expectorate on the floor.
3. Do not wear a beard. If you wear a mustache, keep it short and do not stroke it during working hours.
4. Keep hair covered in the workroom.
5. Keep dirty fingers away from the mouth and nose.
6. Before eating and before leaving the plant always wash hands and face with hot water and soap. Use a brush on the hands and clean the fingernails. Rinse the mouth.

7. Use individual soap and towels.
8. Always take shower before putting on street clothes.
9. Keep body clean:
    (*a*) Outside, by bathing in warm water at least twice a week;
    (*b*) Inside, by drinking plenty of water. Keep your bowels moving at least once a day; regularity in time of movement helps to maintain health; constipation invites lead posioning.
10. Keep teeth clean and in order. See a dentist periodically. A man with bad teeth and gums is seldom healthy.
11. Do not stir up dust; always insist on moist sweeping and moist dusting of work benches and walls.

STIMULANTS.

1. Never drink alcohol in any form; it greatly increases the danger and severity of lead poisoning. Excessive use of any stimulant lowers resistance and increases danger of lead poisoning.

FRESH AIR.

1. Always insist on plenty of fresh air in the workroom.

MEDICAL AID.

1. Learn all you can about lead, its compounds, their uses, their effects upon the human body, so that you may continue your work without danger and intelligently protect yourself and your family.
2. Consult a physician if you notice the frequent occurrence of the following symptoms:
    (*a*) Loss of appetite.
    (*b*) Indigestion.
    (*c*) Constipation.
    (*d*) Nausea.
    (*e*) Vomiting.
    (*f*) Pains in stomach.
    (*g*) Disturbed sleep.
    (*h*) Dizziness.
    (*i*) Weakness of arms, limbs, or body.
    (*j*) Muscular cramp.
    (*k*) Neuritis.
    (*l*) Loss of weight.

WORKROOM PRACTICES.

Remember that if you do not look out for your own health, you can not expect anyone else to look out for it.

1. Don't dust off your workbench with your apron or with anything that will raise dust. If you must remove dust, do it by a wet method.
2. Don't clean off ware on work apron.
3. Avoid splashing or spilling of glaze, both when carrying and when dipping, lest the glaze be raised as dust later.
4. See that ware boards are kept clean and free from glaze so that no dust will be raised in handling them.
5. Avoid raising or scattering dust in any operation—sweeping, brushing, fettling. walking, lifting, or moving ware, saggers, or other equipment and materials.

All these are precautions which the individual may take to safeguard himself against the hazard of his trade or occupation. These same precautions are of further importance because they also conduce to the maintenance of health, which would manifestly be materially increased if certain plant facilities and working conditions were raised to high standard of industrial hygiene and sanitation.

It has been shown in the early part of this report that the ordinary features of plant hygiene have been woefully neglected in the potteries. When grouped the improvements needed are so numerous as to give the impression that the cost of their installation would be prohibitive. It is not our purpose here to dictate a program for plant hygiene which should be accepted in its entirety by each and every pottery; we would, however, emphasize the fact that working conditions have a direct bearing upon the health and efficiency of the worker, upon the quantity and quality of his production, and hence are vital factors in production cost. It is obvious that the worker is handicapped in carrying out the foregoing recommendations in full if the personal service facilities which are found in all modern plants are not provided. We have seen that they are not provided in the majority of plants studied.

PLANT MEANS AND METHODS.

WATER.

It is good policy and an economic practice to install and to maintain an adequate supply of pure drinking water; bubblers, conveniently placed, and water of always palatable temperature.

BATHING FACILITIES.

As an aid toward the elimination of the hazard of lead poisoning to the pottery worker adequate and ample bathing facilities should be provided in all potteries. These facilities should consist of adequate dressing rooms, with lockers provided (either two lockers per man or one with a partition divided into two distinct and separate compartments), sufficient in size to accommodate on the one side the working clothes and equipment of the worker and on the other his street clothing.

Sufficient washbasins or bowls and ample shower baths, with running hot and cold water, should be provided for the use of the workers. Individual soap and towels should be used. It should be a part of the plan of the plant management to educate the employees to appreciate the many advantages gained by the use of bathing facilities and by the elimination of common soap and common towels.

TOILET FACILITIES.

If accumulated for a year the average time lost in going to poorly located toilets would more than pay for installations in places more convenient as to location and distance from the place of work. Old-fashioned privy vaults are not tolerated to-day in any community where public health is appreciated and should not be found in any plant where sanitary ware is manufactured. The use of them is both poor economy and bad advertising. All toilets should be located with regard to the number of workers and the distance from their place of work. Careful supervision of the condition of the toilets should be maintained as to cleanliness, heat, ventilation, light, repair, and supplies, and other factors, the absence of which tends to discourage the use of the toilets.

The plant management should impress upon the employee the dangers resulting, where there is a lead hazard, from prolonged delay in the use of toilet facilities. If this delay could be overcome it is quite possible that the number of cases of plumbism would decrease.

CUSPIDORS.

Ample provision of cuspidors, well distributed throughout the plant, with strict supervision of their daily cleaning and sterilization is a sanitary necessity to prevent the spread of sputum-borne diseases. Expectoration, except in such cuspidors, should be prohibited.

SPECIAL CLOTHING.

Workers should be encouraged in the use of overalls, aprons, caps, head covers, and respirators. It is to the interest of the plant to impress upon the workers the advantages of this special clothing.

LUNCH ROOMS.

In many plants with large personnel it has been found profitable and beneficial to install cafeterias or restaurants. Employees are thereby encouraged to eat away from their work and have the privilege of obtaining their meals at low cost. In the larger potteries such facilities should be instituted.

If the number of workers be too small to warrant the installation of a restaurant, a lunch room should nevertheless be provided and should be centrally located, but not adjacent to any hazardous process that creates dust, smoke, or fumes. Tables, chairs, water, heat, light, and ventilation should be provided, and the room should be made as attractive as possible. In some plants it has been found wise to have the lunch room in combination with the recreation room, with pianos, phonographs, and other facilities for amusement as added attractions to induce the workers to eat in lunch room.

Educating the worker as to the danger of eating in the workrooms and of failing to wash before eating is, however, as essential as the provision of cafeterias and lunch rooms if the plant management expects to decrease the amount of lead poisoning.

PLANT HYGIENE.

ILLUMINATION.

It is hard to justify on any grounds the maintenance to-day of workrooms where the light, either natural or artificial, is so inadequate as to increase the occupational health hazard, as well as to interfere with speed and accuracy in production. There are on the market simple measuring instruments by which every plant manager may ascertain for himself the degree of illumination at the work plane of his employees.

By simple determinations and at a slight cost improvements in lighting may be introduced, the production of the worker increased, and losses from spoilage decreased.

Careful consideration must be given to the processes in each plant as to the amount of illumination required. Care must be taken to avoid the creating of poorly illuminated areas, which tend to cause the sweeper to fail to remove trade waste or dust or which encourage carelessness in cleaning and consequent dustiness. It is these poorly illuminated areas that harbor increased plant dustiness, with its corresponding injury to the worker.

It will be found possible in many cases to improve the illumination by removing obstructions, cleaning and painting the walls, regular cleaning of glass windows, doors, and skylights, and the careful distribution of artificial lights. In artificial illumination care must be given to type, intensity, distance from the plane of work, position, maintenance, and glare.

VENTILATION.

Ventilation is fundamental to plant hygiene.

In most plants to-day the natural ventilation is seldom satisfactory, and this is true of the pottery plants, yet few had provisions for artificial ventilation.

Pottery managers should carefully analyze air conditions, determining the adequacy or inadequacy of the ventilation by the number of cubic feet of air per worker, the number of fresh-air openings, air conditions as to temperature and humidity, the rate of motion of air into the room and the character of the processes therein, and air dustiness or other forms of contamination.

Natural ventilation should be improved, and in all processes where dust is created artificial ventilation should be installed.

DUST AND DUST PREVENTION.

The total loss caused by dust to employers and employees through respiratory diseases and lead poisoning can not be estimated in dollars and cents. That the loss is great is proved by the sick benefits and death benefits paid for this class of diseases by the various organizations of employees.

If the plant management and employees could be brought to realize that the greatest danger they have in the pottery industry is a preventable one—namely, dust—and if they gave careful consideration to the annual losses caused thereby, we feel sure that the following practices would be discontinued:

1. Dry sweeping.
2. Sweeping during work hours.
3. Dirty ware boards.
4. Open glaze containers other than dipping tubs.
5. Lack of care in handling material so as to prevent dust.
6. Splashing and spilling of glaze.
7. Brushing, polishing, and fettling without provisions for the removal of the dust created.

Stringent rules should be made and enforced to prevent the above practices, and in turn the plant management should install the following modern improvements and methods in the plants:

1. Wet sweeping after work hours.
2. Scraping and cleaning ware boards to remove all glaze and dust before reuse.
3. Mixing all glaze and handling material under an exhaust in so far as practicable.
4. The use of some impervious material for dipping-room walls and floors and arranging them so that they can be washed down periodically.
5. Exhausts and hoods on all dust-creating processes, such as polishing, brushing, and fettling.
6. Keeping all lead compounds and compounds in dry or fine granular condition in covered bins or bowls.

PLANT BUILDINGS.

To outline a plant program for the adaptation of plant buildings to sanitary usage, so as to reduce the hazards from lead, would necessitate a list of changes which to any pottery manager would appear costly and hence, in the thought of trade, prohibitive. There are certain changes which must, however, appeal even to such critics as essential. Old buildings so occupied as to cause excessive carrying of raw glaze or of unfired glazed ware or long carrying from tub to racks and from racks to kilns might profitably be rearranged so that a continuous routing of ware would be possible; in fact, the introduction of overhead carriers would be both profitable and safe. In other plants where the floors, workbenches, and walls are of rough surfacing, collecting and holding the dust after sweeping, a resurfacing to obtain a smooth surface is both feasible and essential.

The same improvement might reasonably be introduced in the dipping rooms or wherever splashing and spillage contributes to the lead hazard. We have already noted the need for better lighting and ventilation. Where natural lighting can not be improved because of the lay-out of the plant, artificial lighting may be introduced; and with both methods improvements may be effected by careful attention to the cleanliness of globes, reflectors, and windows. In plants where the carrying of liquid glaze is an objectionable practice, the installation of a pipe-carriage system might advantageously be made.

PLANT PROCESSES, EQUIPMENT, AND MATERIALS.

The most fundamental innovations, in some instances costly, but which in the long run yield profit in excess of the installation costs, decrease the lead hazard, aid in the cleanliness and sanitation of the plant, and save labor, are:

1. Fritting the lead.
2. Use of leadless glazes and substitutes for lead.
3. Use of the least soluble compounds of lead.
4. Automatic ware dipping.
5. The continuous kiln.
6. The mangle.

These are discussed in detail in Section II, Part V.

PLANT MANAGEMENT.

In a last analysis the responsibility for working conditions rests with the management. Sanitary conditions are a part of the economy of production. While it is to the interest of the worker to maintain his health and a higher state of productive efficiency, it is even more to the interest of the plant manager; he must produce, both through quantity and quality of work, profits for the stockholders. It is to his interest, therefore, to see that the workers are not only kept in the mental condition where good will becomes an asset, but are also in the physical condition wherein such good will may be expressed in muscular activity that yields production at the lowest possible cost. The wise plant manager will see the extravagant possibilities that attend the maintenance of working conditions so deleterious to the worker's health. Plant problems are simple where there is a mutual understanding and cooperation both in shaping management policies and in the discipline that must attend the enforcement of such policies.

REGULATIONS.

In order to produce the best hygienic and sanitary conditions in the plants and so far as possible to check lead poisoning, plant managers must formulate regulations and provide means for their enforcement. Such regulations should cover the sweeping and cleaning of the plant, eating in the workrooms, expectorating on the floors, use of common drinking cups and open water containers, handling of materials, temperature of workrooms, and rest periods—where the nature of the work or the strain of posture in performing it necessitates their introduction and observance. Foremen and others that employ workers should be required to see that all workers are instructed as to the particular hazard existing in the process in which they are engaged.

MEDICAL AND SURGICAL CARE.

Medical and surgical relief for the employees, as we have seen, is practically lacking in the potteries. A few larger plants, only, have separate and distinct medical and surgical departments. All the larger plants should have such service. Where separate departments would not be feasible for the smaller plants, group relief methods should be adopted to provide the same advantages.

With medical supervision installed, the following special services should be rendered:

1. Complete physical examination of all workers at the time of employment and periodically thereafter.
2. Placement and replacement of workers, to be made on the basis of their physical condition. To this end, all workers exposed to a lead hazard to be given a physical examination monthly.
3. Personal as well as printed instructions given to the applicant, as to the lead hazard in the pottery industry.
4. Hospital care should be provided for the treatment of incipient cases of lead poisoning. After hospitalization, necessary arrangements should be made to transfer the worker to other duties where there is no lead hazard, and similar arrangements should be provided for incipient cases.
5. Careful study of plant hygiene and safety, coordinated with a comprehensive analysis of plant and medical records, that hazards may be ascertained and programs for their elimination may be adopted.

MODERN IMPROVEMENTS IN POTTERY PRODUCTION WHICH LESSEN THE LEAD HAZARD.

It is not our intention to indicate all the mechanical and physical changes which might be introduced in the pottery industry to improve working conditions and to eliminate the most serious hazards. Labor-saving devices, cost reduction provisions, provisions for increasing output, and like means all are improvements which might, in their adoption, bring increased returns, both to the pottery employees and to the pottery owners, enabling them thereby to institute other changes which would eliminate all hazards resulting from the use of lead. There are, however, three further types of plant improvements which might well be introduced, if not in the form in which they appear in certain plants, yet in the application of the principles underlying them. These three means of improvement may be noted under the headings:

A. Reduction in the amount of lead used in the glaze.
B. Continuous kilns.
C. Mechanical means for dipping.

In attempting to reduce the lead hazard, plans have been successfully worked out, involving first a low lead content and substitutes for lead; second, leadless glazes, and third, a fritted glaze.

GLAZE WITH LOW LEAD CONTENT.

While American potters are inclined to use a high per cent of lead in their glaze, as compared with European potters, and while many maintain that a leadless glaze is not practicable, yet it is possible to lower the lead contents of the glaze, and also to use compounds of lead, less soluble.

In many instances lead oxide may be used in place of white lead (carbonate), since it gives an excellent glaze and is less soluble. In other instances a smaller amount of lead may be used in the glazes by the addition of zinc oxide; in glazes in which zinc oxide is a regular constituent a larger portion of it may be added. In fact, it is hardly a mooted question whether a fritted glaze or a leadless glaze could not be substituted or used in all pottery work. American potteries have many lessons to learn in the mixing of glaze, from abroad, where a lower content gives results.

LEADLESS GLAZES AND SUBSTITUTES FOR LEAD.

Leadless glazes are said to be used with good results in some European potteries. Such glazes are easy enough to formulate, but have certain objectionable features, for which they have been condemned by the pottery makers of America. These objections are almost unsurmountable, with the present method of firing, but many of them would be removed by the application of scientific methods of glaze making and firing. In brief, the objections are as follows: Leadless glazes have less gloss and brillancy; have medium or short heat ranges and higher temperature to fusibility, hence require a higher content of boric oxide than glazes containing lead and are less adaptable for underglaze or overglaze work.

Zinc oxide, which is often used as a substitute for lead, improves color, gives more gloss, gets away from egg-shell finish, helps to correct crazing, gives longer heat range and easier fusibility, obviating use of a large quantity of lead and boric acid.

Objections to its use are that it lessens the possible range of overglaze colors and increases solubility of glaze in caustic washing solutions used in hotels and elsewhere.[4]

FRITTED GLAZES.

Many efforts have been made from time to time to produce a good fritted glaze. This seems to be the common ground on which all investigators meet as to the best method of eliminating lead poisoning from the pottery industry.

We share the conviction that a vast improvement might be made in the reduction of the lead hazard if the lead were fritted and if the fritted glaze were uniformly used. To the end that the feasibility of such plans might be determined, the Service consulted with R. L. Stull, at the Ceramic Laboratory, United States Bureau of Mines, who has been working in the field for some time. Mr. Stull's report follows:

FRITTING THE LEAD.

In order to reduce the hazards of lead poisoning in potteries using glazes of the white-ware type, it is advantageous to frit all of the lead. If the frit is properly constituted it is practically insoluble to most dilute chemical reagents and thereby eliminates the possibility of lead poisoning to workmen who come in contact with the glaze. However, the weighing of the frit, its mixing and fritting operations, offer opportunities for lead poisoning; but these operations are usually confined to two or three workmen, so that the number of employees coming in contact with soluble lead is reduced to a minimum. Much can be done in the way of education. If the workmen who prepare the frit understand the causes and effects of lead poisoning and are compelled to take proper precautions, no contraction of lead poisoning need occur.

There are three ways by which the frit may be changed so as to include all the lead. First, the lead may molecularly replace part or all of the whiting in the original frit or, second, it may replace parts of the whiting, zinc oxide, and barium carbonate, if the two latter are present. This can generally be done without changing the general frit formula to its oxygen ratio. Third in "high lead" glazes maturing at low temperatures the amount of raw lead in the glaze may be so great that there are not sufficient replacement RO's (Whiting, zinc oxide, etc.) in the frit to take care of the lead. In such a case it becomes necessary to construct an entirely new frit, which should contain sufficient alumina and silica introduced in the form of feldspar clay and flint to form a well-balanced frit low enough in solubility to be harmless. Glazes Nos. 1 and 1A represent a case in which all the lead is introduced into the frit by molecularly replacing part of the whiting.

Batch composition, glaze No. 1.

	Per cent.
Frit	42.35
Feldspar	8.01
Whiting	5.72
White lead	19.89
China clay	6.58
Flint	17.45

Formula, glaze No. 1.

$$\left.\begin{array}{l} 0.11\ K_2O \\ .11\ Na_2O \\ .53\ CaO \\ .25\ PbO \end{array}\right\} \left.\begin{array}{l} 0.25\ Al_2O_3 \\ .40\ B_2O_3 \end{array}\right\} 2.8\ SiO_2$$

$$\overline{1.00\ RO}$$

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[4] Abstracts from Notes on Pros and Cons of use of Zinc Oxide in Glazes, by P. C. Purdy, vol. 17, pp. 520-526, A. C. S., 1919.

Batch composition, frit for No. 1.

	Per cent.
Feldspar	17.20
China clay	6.65
Borax	21.65
Whiting	17.01
Boracic acid	11.51
Flint	25.98

Formula, frit for No. 1.

$$\left.\begin{array}{r}0.12\ K_2O\\ .22\ Na_2O\\ .66\ CaO\end{array}\right\}\left.\begin{array}{l}0.22\ Al_2O_3\\ .80\ B_2O_3\end{array}\right\}2.6\ SiO_2$$

$$\overline{1.00\ RO}$$

Combining weight=296.3.

Since it requires 0.5 molar equivalents of frit for the glaze, the $0.25\ PbO \div 0.5 = PbO$ may be substitutes for 0.5 CaO in the original frit formula. The formula for the new frit for 1A then becomes:

$$\left.\begin{array}{r}0.12\ K_2O\\ .22\ Na_2O\\ .16\ CaO\\ .50\ PbO\end{array}\right\}\left.\begin{array}{l}0.22\ Al_2O_3\\ .80\ B_2O_3\end{array}\right\}2.6\ SiO_2$$

$$\overline{1.00\ RO.}$$

Combining weight=379.3

and the batch composition for frit for 1A:

	Per cent.
Feldspar	14.29
Borax	18.00
Whiting	3.43
White lead	27.62
China clay	5.52
Boracic acid	9.56
Flint	21.58

The introduction of 0.5 molar equivalent of the new frit into the glaze formula, together with the proper amounts of feldspar, whiting, china clay, and flint, gives a glaze of the same composition when fired as glaze No. 1.

Following is the batch composition of the new glaze in which all the lead is fritted:

Batch composition, glaze 1A.

	Per cent.
New frit	54.67
Feldspar	8.01
Whiting	12.98
China clay	6.70
Flint	17.64

Glaze No. 2 represents a condition where the lead is substituted for part of the whiting and all the zinc oxide.

Following are the batch compositions and formulæ of the glaze and frit:

Batch composition, glaze No. 2.

	Per cent.
Frit	54.37
Feldspar	6.76
Whiting	3.65
White lead	18.83
China clay	4.71
Flint	11.68

Formula, glaze No. 2.

$$\left.\begin{array}{r}0.10\ K_2O\\ .15\ Na_2O\\ .27\ CaO\\ .15\ ZnO\\ .33\ PbO\end{array}\right\}\left.\begin{array}{l}0.22\ Al_2O_3\\ .30\ B_2O_3\end{array}\right\}2.5\ SiO_2$$

$$\overline{1.00\ RO.}$$

Batch composition, frit for No. 2.

	Per cent.
Feldspar	15.32
Borax	26.32
Whiting	6.89
White lead	10.67
Zinc oxide	5.58
China clay	7.11
Flint	28.11

Formula, frit for No. 2.

$$\left.\begin{array}{l}0.10\ K_2O\\ .25\ Na_2O\\ .25\ CaO\\ .25\ ZnO\\ .15\ PbO\end{array}\right\}\left.\begin{array}{l}0.2\ Al_2O_3\\ .5\ B_2O_3\end{array}\right\}2.5\ SiO_2$$

$1.00\ RO$

Combining weight=298.

Since the glaze requires 0.6 molar equivalent to the frit and since the frit formula contains 0.15 PbO, 0.15 PbO×0.6, or 0.09 PbO, is brought into the glaze by the frit. The 0.33 PbO in the glaze formula less 0.09 PbO introduced by the frit leaves 0.24 PbO which is introduced into the glaze in the form of white lead and which is to be incorporated in the frit in order that all the lead shall be fritted.

The 0.24 PbO÷0.6 gives 0.4 PbO to go into the frit formula and replace 0.4 equivalent of the other members in the RO. This may be done by replacing 0.25 ZnO. 0.15 CaO=0.4 RO, which gives the following as the formula and batch composition of the new frit:

Formula, frit for 2A.

$$\left.\begin{array}{l}0.10\ K_2O\\ .25\ Na_2O\\ .10\ CaO\\ .55\ PbO\end{array}\right\}\left.\begin{array}{l}0.2\ Al_2O_3\\ .5\ B_2O_3\end{array}\right\}2.5\ SiO_2$$

$1.00\ RO$

Combining weight=358.

Batch composition, frit 2A.

	Per cent.
Feldspar	12.91
Borax	22.17
Whiting	2.32
White lead	32.93
China clay	5.99
Flint	23.68

Following is the batch composition of the new glaze, in which 0.6 equivalents of the new frit is used. The formula of the glaze is the same as No. 2.

Batch composition of glaze 2A.

	Per cent.
Frit 2A	66.28
Feldspar	6.86
Whiting	6.48
Zinc oxide	3.75
China clay	4.78
Flint	11.85

No. 3 may be called a "high lead" glaze in which part of the lead is fritted and part is added to the glaze batch as white lead.

Batch composition No. 3.

	Per cent.
Frit	42.60
Feldspar	6.52
Whiting	1.76
White lead	30.23
China clay	3.78
Flint	15.11

Formula, glaze No. 3.

$$\left.\begin{array}{l}0.09\ \mathrm{K_2O}\\ .07\ \mathrm{Na_2O}\\ .24\ \mathrm{CaO}\\ .60\ \mathrm{Pbo}\end{array}\right\}\left.\begin{array}{l}0.14\ \mathrm{Al_2O_3}\\ .14\ \mathrm{B_2O_3}\end{array}\right\}2.3\ \mathrm{SiO_2}$$

$1.00\ \mathrm{RO}$

Batch composition, frit for No. 3.

	Per cent.
Feldspar	16.15
Borax	15.53
Whiting	10.46
White lead	29.98
Flint	27.88

Formula, frit for No. 3.

$$\left.\begin{array}{l}0.10\ \mathrm{K_2O}\\ .14\ \mathrm{Na_2O}\\ .36\ \mathrm{CaO}\\ .40\ \mathrm{PbO}\end{array}\right\}\left.\begin{array}{l}0.10\ \mathrm{Al_2O_3}\\ .28\ \mathrm{B_2O_3}\end{array}\right\}2.2\ \mathrm{SiO_2}$$

$1.00\ \mathrm{RO}$

Combining weight=290.8.

In the glaze, 0.5 equivalent of the frit is introduced, which accounts for 0.2 PbO and leaves 0.4 PbO to be added as white lead. The 0.4 PbO + 0.5 = 0.8 PbO. This added to the 0.4 PbO already in the frit formula gives 1.2 PbO. Since the formula is based upon unity RO, all the PbO can not be taken care of simply by replacement of other members in the RO. It therefore becomes necessary to construct a new frit. In order to frit such a large quantity of lead and produce a frit relatively low in solubility, it is necessary to frit a large portion of the glaze ingredients.

The following is an illustration showing how the problem of fritting all the lead in glaze No. 3 was solved under practical working conditions:

Formula, frit for No. 3A.

$$\left.\begin{array}{l}0.1125\ \mathrm{K_2O}\\ .0875\ \mathrm{Na_2O}\\ .0500\ \mathrm{CaO}\\ .7500\ \mathrm{PbO}\end{array}\right\}\left.\begin{array}{l}0.1125\ \mathrm{Al_2O_3}\\ .1750\ \mathrm{B_2O_3}\end{array}\right\}2.2\ \mathrm{SiO_2}$$

$1.00\ \mathrm{RO}$

Batch composition, frit for No. 3A.

	Per cent.
Feldspar	16.21
Borax	8.66
Whiting	1.30
White lead	50.13
Flint	23.70

Combining weight=341.

Batch composition, glaze No. 3A.

	Per cent.
Frit 3A	82.14
Whiting	6.02
China clay	3.89
Flint	7.95

ADVANTAGES OF FRITTED GLAZE.

Besides reducing the hazards of lead poisoning, the advantages of fritting the lead are that it reduces the temperature of the fritting and gives a frit that grinds more readily to a fine condition. In case of No. 3 glaze, where it becomes necessary to frit a larger proportion of the materials, it tends to lower the maturing temperature of the glaze.

All substances are volatile at some temperature and pressure. During fritting, the lead, borax, and boracic acid lose most by volatilization, especially during the fusion and gas-evolution stages. However, it is not evident that the loss of lead in fritting is any greater than that which occurs in the glaze during the glost fire, when the lead is added to the glaze in the raw or unfritted form.

During the fusion of the frit, the lead oxide, as well as the borax and borac acid, enters into solution and becomes more or less combined chemically with other components, and in that condition the rate of volatility is much reduced.

From what we have stated in sections I and II it will be seen that among the advantages of fritted lead are the following:

1. If frit is properly constituted, it is practically insoluble to almost all dilute chemical reagents, and the possibility of lead poisoning to workmen who come in contact with the glaze is thereby eliminated.
2. By the use of frit, the lead hazard is limited to the few workmen engaged in making the frit.
3. Fritted lead can be used as such for working glaze or in various concentrations, thereby lessening the total amount of soluble lead present in a glaze compound, and hence decreasing the possibility of lead poisoning.

CONTINUOUS KILN.

Continuous kiln firing has not yet been introduced generally, but its success has been demonstrated. The tunnel kiln appears to be the most successful type of continuous kiln, but its general adoption by the industry is prevented by lack of capital and by the objections of some of the workers and plant executives. The exposure to lead poisoning in a kiln room is greatly reduced by the substitution of the continuous kiln for the ordinary intermittent kiln.

In tunnel kilns saggers are not necessary, and by dispensing with saggers the tunnel kiln eliminates the lead hazard attendant upon sagger washing and the fatigue hazard that accompanies the loading of kilns. The heat hazard is also reduced, and risk from exhaust or escaping gases is minimized.

Moreover, it is alleged that these advantages follow from the use of the tunnel kiln, not only without increased cost but at an actual reduction in the operation charges, because of the use of less fuel and the elimination of wastes and of seconds in the ware.

At one time when the field work of the survey was conducted one continuous kiln was found in operation, and since that time informal tion has been received that 11 more have been installed in various plants.

As we have said in previous sections of this report, many of the workmen in and around the kilns are affected with plumbism. It is for the protection of these workmen that we mention the tunnel kiln and enumerate its advantages.

AUTOMATIC WARE DIPPING.

Automatic ware dipping is successfully accomplished in glazing tile, but mechanical dipping has not to any extent replaced the hand dipping of earthenware, as far as we have been able to ascertain.

However, one manager interviewed claims to have perfected a device for dipping all ware except "jugs" (meaning any ware similar to a jug or pitcher). This device, he says, has been successfully operated. He is now working to perfect it for all ware. In connection with this device he has compounded an acid solution which will so even the surface of all ware that one standard dilution of glaze will properly coat it. He has the very good idea of transferring the dipped ware directly from the dipping device to the cars which run through the tunnel or continuous kiln. This will do away with the ware boards and the handling of dipped ware after it has dried, and will thus eliminate much of this present potential source of glaze dust.

THE MANGLE.

The English mangle is not only a labor-saving device, but it reduces the dangers from exposure to lead. The dipped ware from the tub is placed directly upon the shelf of the mangle and is carried up, dried, and conveyed on an endless wheel to a helper, whose duty is to remove the superfluous glaze on a grating, equipped with a suction draft from a blower, which carries away the dry glaze dust.

APPENDIX A.

CLAGUE-OLIVER ELECTROLYTIC TREATMENT FOR LEAD POISONING.

OPINIONS ON THE EFFICIENCY OF THE TREATMENT AND SOME RESULTS NOTED IN THE POTTERY SURVEY.

TREATMENT FOR THE PREVENTION AND CURE OF LEAD POISONING.

The Clague-Oliver electrolytic treatment of plumbism consists in placing the patient with the feet immersed in a foot bath of normal salt solution, which is 60 grains of salt to a pint of warm water, and with the hands and arms resting in a comfortable manner in a hand bath of the same solution and then inserting the positive electrode from a 110-volt direct current in the foot bath and the negative electrode in the hand bath. The patient should not touch either of the electrodes, and caution must be taken that the salt solution does not reach the binding post or wire of the electrodes.

The standard apparatus for this treatment consists of a controller board with lamp and meter, current-supply cord and socket plug, three lead bifurcated cords, six electrodes, six baths (three foot and three hand baths). The baths may be of earthenware or of wood, and the electrodes of pure aluminum. If the current is introduced gradually by a suitable rheostat until the meter shows from 30–50 milliamperes no shock is felt, nor is any unpleasant sensation experienced by the men.

The theory upon which the treatment is based is as follows: When an electrical current is passed through a solution of salt—that is, an acid united with a base—the acid collects at the point where the positive wire enters and the base goes to the negative pole. The two entities in each salt are termed ions, and they can pass through membranes. Since the positive pole is placed in one bath and the negative in the other, the current is assumed to pass through the body of the patient. It is by this reasoning that Sir Thomas Oliver explains the presence of lead on the negative pole; also the disappearance of the blue line from the gums of workmen treated by the double electrical bath.

The duration of the bath may be from 30 minutes to one hour, according to the condition of the patient. For prevention of poisoning and elimination of lead daily absorbed, an average of three baths per week has been found sufficient. In acute cases daily baths are recommended as a cure.

Dr. H. Lewis Jones, of St. Bartholomew's Hospital, about 18–20 years ago treated cases of lead poisoning by means of a single electric bath, and he became enthusiastic over the efficacy of the treatment. The standard form of the Clague-Oliver electrolytic apparatus has been installed in the Mercer Hospital, Trenton, N. J., the East Liverpool City Hospital, East Liverpool, Ohio, and the Wardner Hospital, Kellogg, Idaho.

The tests so far made to determine the efficiency of the Clague-Oliver treatment of plumbism have been few and lack scientific exactness. The only animal experimentation made by Sir Thomas Oliver, who is perhaps the strongest advocate of the electrolytic method, was on a rabbit, which died after having received lead almost daily for three years in the form of a solution of nitrate of lead dropped into the back of its mouth from a pipette. In the course of three years it received 1,095 grains of nitrate of lead, equivalent to 684 grains of metallic lead. Some months after having taken the drug the animal became painlessly paralyzed. It was treated electrolytically by the two-bath system. Under this method of treatment the animal recovered the use of its limbs. In a few days it was quite well again. The administration of lead was resumed, and in the course of nine or ten months the animal again lost the use of its limbs. Treatment by the double electric bath soon restored the rabbit to its former health and vigor. By the end of another year these were again lost, the animal became emaciated and died. In the liver, kidneys, and spleen there was found on microscopical examination a distinct increase of connective tissue, and from the liver and kidneys lead was extracted (1).

This single experiment is not satisfactory, because it takes into account only one factor—that is, the amount of lead given to the rabbit. Other important factors, such as the amounts eliminated by natural means, the amounts absorbed, the amounts eliminated by means of the electric baths, and the behavior of a control rabbit given the same amounts of lead at the same intervals, the electric baths being omitted, have not been taken into account.

On the other hand, experimental work performed by Oxley and Goadby in England in 1914 failed to prove that any lead salt will undergo deionization by electrolysis in the body. On the contrary, at no time did they find lead on the electrodes or in the solution, while the serum of all the animals experimented on contained lead.

In an article published October 3, 1914, in The Lancet, London, W. H. F. Oxley gives the results of his experiments with the electric bath treatment for lead poisoning. A summary of the article follows:

Experiment No. 1.—Eight cases of lead absorption.—Three cases were given 18 baths, 2 were given 14 baths, the others were given 6, 7, and 8 baths. No changes were noted in the lead lines or signs of lead absorption. Languid feeling was noted after the bath.

Experiment No. 2.—One man with lead absorption.—Arms and legs were scrubbed and were put in the baths, with no current passing; no lead was found in the water at the end of 40 minutes. Then a current of 35 M. A. was passed for 40 minutes. The electrodes were removed and the water tested for lead with negative results. The electrodes were tested for lead, and a black (sulphide) precipitate was obtained, which might be mistaken for lead, but positive tests showed this to be iron in the electrodes.

Experiment No. 3.—Same as experiment No. 2, except that platinum sheets were used in place of aluminum electrodes. No lead was found in the water or on the electrodes.

Experiment No. 4.—Six cases of lead absorption were treated with the electric baths, the same water and electrodes being used for all the treatments. No lead was found in the water or on the electrodes.

Experiment No. 5.—Twenty-four hour specimens of urine of two old lead workers were examined for lead, with negative results. The next day treatments were given, with the use of 35 M. A. for 40 minutes; and 24-hour samples of urine were collected. No lead was found in urine, electrodes, or water.

Experiment No. 6.—A rabbit was given large doses of lead during a period of time not specified and was then given the treatment, at first for 2 hours, using 35 to 40 M. A. current, and then for 4 hours. No lead was found in the water of the baths or in the electrodes. The animal died; the body was cut up into a number of pieces, placed in an electric bath through which a current of 90 M. A. was passed for 3 hours. No lead was found in the water or on the electrodes. The liver was emulsified, placed in a dialyzer in an electric bath and a current of 35 M. A. was added for 40 minutes.

No lead was found in the water or on the electrodes. Chemical analysis of the liver showed that 2.2 milligrams of lead were present.

Conclusion.—No good would result from continued treatment with the electric baths. The proportion of lead ions in a body (fatally poisoned) to the tissue ions is not over 1 to 1,600. All the ions use up the current; the available current can not deposit over 0.04 milligram of lead per bath.

Another point which is overlooked by advocates of this treatment is the slow rate of penetration of ions through animal membrane. With this factor and the above factor taken into account, the total possible effect of an electric bath would be to remove from the superficial layers of the skin not over $\frac{1}{1500}$ of a gram of lead.

In the issue of The Lancet in which Oxley's article appears there is also an article by Kenneth Goadby. A summary of Goadby's experiments and conclusions on the electrolytic prevention of lead poisoning is given below.

Iron (as well as some copper) was found on the aluminum electrodes and in the water and salt first used. Platinum electrodes were therefore used instead of aluminum electrodes, and pure water and salt.

Experiment No. 1.—Four cats and two dogs were given lead and were treated with the electric baths. No lead was found in the water or on the electrodes. It was found to be impossible to remove lead from the liver of a lead-poisoned animal by the electrolytic method. Chemical analysis of the liver showed the presence of lead; this lead was probably present as an albuminate. A metal absorbed by albumin is undissociated. Without dissociation, no deposit is likely to occur.

Experiment No. 2.—A 10 per cent solution of lead nitrate was added to a 5 per cent solution of albumin; the substance then gave combined reactions of lead and albumin. Some free lead was also present. Ten grams of lead albuminate were treated with 25 c. c. normal horse serum, the supernatant clear serum was pipetted off and placed in a dialysis tube of parchment paper, suspended in a normal salt solution. A platinum electrode was placed in the tube and another in the surrounding bath. A current of 0.1 ampere at 8 volts was passed for 14 hours. The electrodes were tested for lead, with negative results. The serum was tested and was found to contain lead.

Conclusion.—Lead chloride, or any soluble salt of lead, forms a thick, curdy, white precipitate in the presence of lead, and therefore lead circulating in the blood is unlikely to remain as a simple organic salt; but unless it does so—there is no evidence to show that it does—it will not undergo ionization by small electric currents. Iron is easily deposited by electrolysis; if, therefore, Sir Oliver's contention is correct, that lead is eliminated electrolytically, iron from the hemoglobin of red blood corpuscles should also be removed. Small quantities of lead are no doubt eliminated or washed off the skin.

So far experiments do not establish any grounds for belief in the prevention or the successful treatment of lead absorption or lead poisoning by means of the electric bath.

The experiments described by Oxley and Goadby are more careful and scientific than those described by Oliver. Oxley's and Goadby's findings support each other, and their conclusions agree; but they fail to confirm Oliver's findings in any particular.

As a further test of the efficiency of the treatment, Dr. A. D. McCracken, in a recent communication to this office, proposes the following experiment: "Determine the amount of lead in the urine for three successive days without treatment, then for three days under intensive electrical treatment, and for the three days following. This will not include the lead excreted by the bowel, and as we know that free purgation does relieve the condition, it may be that much the larger part of the lead is eliminated by the bowel, and possibly the experiment should include the bowel discharges also. I suppose that the same method for finding the lead in the urine would be applicable to the feces."

However, present-day opinion among physicians is practically worthless. Careful records have not been kept, and opinions are based largely on statements made by patients rather than on observation of patients for a long period of time. The differences in the opinions offered render them of little value.

Sir Thomas Oliver maintains that persons suffering from lead poisoning show few, if any, signs of plumbism after two or three weeks' treatment with the electrolytic process, while a bath once or twice a week prevents lead from settling in the system; and that rheumatic joints, so-called, improve, and double wrist-drop slowly disappears (2).

While Dr. McCracken, of the Wardner Hospital, believes that there is a rapid clinical improvement with the treatment, Schmitter treated 12 patients without benefit; but he does not state whether the condition of the patient was such that structural alterations of the tissues had advanced too far.

Botterick, while he admits that lead is found in the water of the bath after electrical treatment, thinks that this lead comes possibly from the skin, for lead compounds are known to enter into such close combination with the skin that weeks after men have left off work, and after repeated careful cleansing of the skin, lead can still be detected in the water of the bath.

In attempting to find data in addition to that secured from a physical examination of workers in exposed processes, in order to make a definite statement as to the amount of sickness and death occurring from lead among the pottery workers of New Jersey, Acting Asst. Surg. Eloise Meek states, after a visit to the hospital to inspect the Clague-Oliver machine which the Brotherhood of Operative Potters had placed there:

"It was operated by a nurse in charge; a motor-generator set, 110 volts, connected through a rheostat registering 0.01–0.3, was connected to a positive and negative carbon plate 9 by 4, each of which was placed in a separate fiber tub half filled with a warm solution, to act as an electrolyte. The patient places the affected member, or part, in one of the tubs, and another extremity is put into the alternate tub. The current is then applied, and a gradually increasing current density is used for three-quarters of an hour. Treatments are supposed to be given twice a week, continuing for a minimum of six weeks.

"The nurse stated that most of the cases improved, although, when permission was asked to see records, it was explained that as the patients were sent by the union no records or names were kept, treatments being free and patients coming voluntarily. Her report had merely listed 22 cases as treated, but did not indicate whether all were pottery workers. One case, the most pernicious, was not a pottery worker."

A more recent visit to the Mercer Hospital revealed the fact that the pottery workers were taking fewer treatments, with longer intervals between treatments, although they maintained that they derived some benefits from the treatments.

A survey made by Asst. Surg. Marvin D. Shie (R.), of the East Liverpool City Hospital, indicates that 36 pottery workers received treatment during a period of five months, with a total of 316 treatments. It is interesting to note that only one man took the treatment for the prescribed length of time. He had wrist-drop when he began the treatment, and wrist-drop when he finished. He was somewhat improved, however, but his improvement may well have been due to his absence from work for part of that time. The person who took the next highest number—35—is dead. She died of lead poisoning. The other people who have taken the treatment show no physical improvement; in fact, with some of them the intoxication has slowly progressed in spite of the treatments, although some of their symptoms may be alleviated. While the opinion of many of the potters themselves is that the treatment is of some value, this belief does not seem to have been strong enough to cause them to take it with any regularity. This lack of regularity, shown by the fact that only 316 treatments were taken when 1,500 to 2,000 should have been taken, lessens the value of any conclusion which might be drawn as to the results. The statistics given at East Liverpool Hospital are as follows:

October 1, 1918–February 25, 1919.

Number of persons treated	36 (1 female).
Total number treatments given	316 (30 minutes each).
Average number treatments per case	8.8; per month, 1.8.
Minimum number treatments per case	1 per month.
Maximum number treatments per case	43; per month, 8.6.
Occupations of persons treated	24 dippers, 1 kiln hand, 1 presser, 10 not stated.
Average age of 24 persons treated	46.1 years.
Average length of time (24 persons) in occupation	27.5 years.

The men who had taken the treatments were questioned as to their effects. Most of them made favorable statements, the substance of which is as follows:

1. The patients always feel better immediately after the treatment. This sense of increased well-being often lasts for several days.
2. Appetite is increased.
3. Insomnia is diminished. Sleep is promoted.
4. Those who have wrist-drop and weakness of the muscles of the forearm state that their muscles are stronger immediately after the treatment, and that they are able to grasp things better.
5. Headaches are decreased and diminished in severity.
6. Usually some slight gain in weight is made, probably because of increased appetite and better sleep.

The benefit thus experienced is of no little value, even though it is almost entirely symptomatic. It means much to men who have been suffering from insomnia, headaches, and local and general asthenia to get even temporary relief when they have taken a "treatment." They fallaciously reason from the relief to the elimination of the cause, notwithstanding the fact that in the diagnosis of the examiner plumbism has not decreased, but rather has slowly progressed in some cases. Not enough pottery workers have used the treatment with sufficient regularity to make an evaluation of its worth as a preventive measure possible. One definite result, though, follows the use of the treatment. It does tend to encourage pottery workers to exercise more care in personal hygiene, cleanliness of hands and person, the use of laxatives when they are needed, the keeping of better hours, and like practices, which in themselves help toward prevention and cure. As an adjunct to other treatment, the method is of probable value simply for its symptomatic effects.

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(2) Oliver: Diseases of Occupation, third edition, p. 438.

APPENDIX B.

CHEMICAL EXAMINATION OF LEAD GLAZES.

The procedure and the technique followed at the Hygienic Laboratory for the determination of the amounts of the soluble and the total lead content in the glaze samples are here given. Although not all the samples were analyzed at this laboratory, the method outlined is similar to that used in the other laboratories.

HANDLING OF SAMPLES.

The preliminary handling of the samples depends entirely on whether the sample is received in the powdered form or suspended in a liquid. The powdered samples are thoroughly ground in a mortar with a pestle until the lumps are broken. The thoroughly mixed sample is then transferred to a stoppered bottle. The samples suspended in liquid are kept stoppered in the original containers, but are thoroughly shaken before analysis is made.

DETERMINATION OF WATER.

In the powdered samples: Weigh 5 grams of the powdered sample into a tarred porcelain dish and dry at 100° C. until there is no further loss in weight. The loss in weight will represent the water present. The resulting dried sample is then transferred to a glass-stoppered bottle and reserved for determination of lead.

In the liquid samples: After thoroughly mixing the sample in the bottle, weigh 10 to 20 grams of the sample into a tarred porcelain dish and dry at 100° C. until residue can be powdered with a spatula. After the dry residue in dish is broken with a spatula, return the dish and sample to oven again and dry at 100° C. until there is no further loss in weight. The loss in weight will represent the water present. The resulting dried sample is then transferred to a glass-stoppered bottle and reserved for determination of lead.

DETERMINATION OF SOLUBLE LEAD.

Weigh in duplicate 0.15 gram of the dried sample into a glass-stoppered bottle and, after adding 150 c. c. of 0.25 per cent hydrochloric acid, shake for one hour in a shaking machine at a rate of 200 excursions per minute. Transfer contents of bottle to a 200 c. c. volumetric flask and dilute to mark with water. After one hour of standing, filter the sample and transfer 100 c. c. aliquot to a 300 c. c. Erlenmeyer flask. Add 2 c. c. of N/5 acetic acid, saturate with hydrogen sulphide, and allow to stand overnight under bell jar. Filter, transferring entire precipitate with aid of first filtrate. Wash the precipitate six times with 10 c. c. portions of a solution of H_2S containing 10 c. c. of saturated aqueous solution of H_2S, 100 c. c. of water, and 5 c. c. of N/5 acetic acid. Return the filter containing the precipitate to the original Erlenmeyer flask and add 20 c. c. of 1–10 HNO_3. Place a funnel in the mouth of the flask and boil moderately for five minutes. Filter, wash residue six times with about 10 c. c. each of hot water, and evaporate filtrate on steam bath to about 10 c. c. Cool, add 5 c. c. of concentrated sulphuric acid, and heat until copious SO_3 fumes are given off. Cool, dilute with 5 c. c. of water, and add 150 c. c. of 50 per cent alcohol. Mix and allow to stand overnight. Filter through a tarred Gooch crucible, and wash six times, filling the crucible each time with 50 per cent alcohol, finally washing with 10 c. c. of 95 per cent alcohol. Dry the crucible and lead sulphate two and one-half hours at 100° C., and weigh. The increased weight of crucible is the lead sulphate. Using the factor 0.6832, calculate the per cent of soluble lead in the sample.

DETERMINATION OF TOTAL LEAD.

Weigh 1 gram of the dried sample into a 100 c. c. casserole, add 30 c. c. of 1–1 nitric acid, and evaporate to dryness on steam bath. Take up residue with hot water and filter, washing the residue on filter paper with hot water. Reserve filtrate for combination with filtrate from fusion of residue. Transfer residue and filter paper to platinum crucible, dry, and ignite cautiously until paper is nearly ashed. Add 4 grams of fusion mixture (5 parts Na_2CO_3 and 7 parts K_2CO_3) to residue in crucible, and fuse until fusion is complete. Remove crucible to casserole and dissolve the fused sample in a weak aqueous solution of HCl until crucible is clean. Filter the resulting solution and wash residue on filter paper until free of solids. Combine the filtrate with above filtrate, evaporate, and transfer the combined filtrate to a 200 c. c. volumetric flask. Dilute to mark and mix thoroughly. Take two 40 c. c. aliquots and evaporate to dryness in 200 c. c. casserole. Add 30 c. c. of 1–1 HNO_3 and evaporate to dryness again. Take up with hot water and transfer to 300 c. c. Erlenmeyer flask, diluting to 100 c. c. mark. Add 5 c. c. of N/5 acetic acid, saturate with H_2S, and allow to stand overnight under bell jar. Filter the lead sulphide, and follow the same procedure as given under the determination of soluble lead, weighing the lead sulphate and calculating the per cent of total [illegible] in the sample.

APPENDIX C.

STUDIES OF EMANATIONS FROM LEAD GLAZES.

In our efforts to evaluate all the factors which perchance might help to explain the higher incidence of lead poisoning among the dippers, our attention was attracted to J. L. Breton's (1) statement that his experiments, as well as those of M. Trillat, Dr. Heim, and others, proved the emanations and tension of fumes of the carbonate and the oxides of lead. Since these compounds are used in the glaze, it occurred to us that if emanations are given off from the glaze in the open tubs over which the dipper stands he is exposed to an added hazard. This led to the following study and experiments by Assistant Chemist Harry W. Houghton, of this office, who conducted the work at the Hygienic Laboratory:

"In the search for literature pertaining to the hazards of the pottery industry there was found a publication by Breton (1) in which the author described in detail the discovery of emanations from fresh white-lead paint, by the detection with acetic acid solution, of tetramethyl-diamino-dyphenylmethane, Trillat's reagent, which produced a blue color with lead peroxide. The same author cited four other similar investigations, among which were emanation studies on the oxide and carbonate of lead, but in only one of these investigations did the results confirm his experiments. In the majority of the investigations no emanations were found. Although there has been an evident diversity of opinion as to the existence of emanation from lead compound, no further investigation has been undertaken since this publication in 1911.

"Since some of these lead compounds declared by Breton to give off emanations were present in lead glazes used in the pottery industry, it was decided to repeat these experiments in order to determine whether such glazes produce emanations; for if they do so, these emanations undoubtedly present another hazard to workers in pottery.

HISTORICAL REVIEW.

"In 1903 Breton (1) conducted a series of experiments for the determination of emanations from fresh white-lead paint, by detection with tetramethyl-diamino-dyphenylmethane,[1] which when dissolved in acetic acid (Trillat's reagent) gave a distinct blue color with peroxide of lead, resulting in the formation of the corresponding hydrol, $CH.OH(C_6H_4N(CH_3)_2)_2$.

"About the same time the problem was worked on by several other investigators, among whom were Trillat (2), Bezanoon (3), Gautier (4), and Heim and Hébert (5). Most of these investigators, excepting only Breton, and Heim and Hébert, obtained no emanations. The bacteriological studies conducted by Trillat (2) and Marie (6), in which the bacterial cultures were incubated in chambers freshly painted with white-lead paint, showed in the majority of the experiments that there was a retardation of the bacterial growth.

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[1] This tetramethyl base was prepared as follows: A mixture composed of 30 grams of dimethylaniline, 10 grams of formaldehyde, and 200 c. c. of 5 per cent sulphuric acid solution was heated on a water bath for one hour. After the mixture cooled, an excess of sodium hydroxide was added, and the excess of dimethylaniline and the trace of amine were removed by passing a strong stream of steam through the mixture for 10 minutes. When it had cooled, a mass of crystals settled out, which were removed and recrystallized in alcohol. This procedure gave 15 to 20 grams of the base. The preparation of this base is also given in Farbstoff-Tabellen (1914), by G. Schultz, p. 168.

"Trillat reported that he did not obtain any indication of lead emanations, chemically, using the reagent prepared from tetramethyl-diamino-dyphenylmethane; yet Breton conducted similar experiments, spreading the white-lead paint over a large area, and obtained positive evidence of small amounts of lead emanations.

"In his studies Breton arranged a series of freshly-painted boxes under a bell jar in such a manner as to allow a current of air to circulate and be exhausted through a tube connected with an absorption chamber containing 10 per cent sulphuric acid, which held the lead emanations. The sulphuric-acid solution was evaporated to dryness, and lead sulphate was obtained, which was later reduced to lead peroxide by treatment with alkaline hypochlorite. It is supposed that the remaining lead peroxide was washed free of chlorine and hypochlorite and was then dissolved in acetic acid and tested with Trillat's reagent. The production of a blue color showed the presence of lead emanations.

"Heim and Hébert followed the procedure of Breton to a certain extent, but outlined a method which showed a tension of vapors from carbonate and oxide of lead. The technique of these authors was as follows: The air was first drawn through absorption tubes containing sulphuric acid and caustic potash, to free it of all acid or basic vapors which might be present in the atmosphere; then through a long tube (1–2 cm. in diameter) in which was placed the lead compound, held at the proper temperature; if the compound was in the pulverized form, the two extremities of the tube were closed with cotton plugs to prevent the passage of any dust; the air was then let through a U-tube filled with cotton, which also served to retain any dust; and then into a Gautier absorption tube, in which was placed 10 c. c. of sulphuric acid, which held the emanation of lead; the air was finally passed through a gas meter in order to measure the rate of flow of air that passed through the apparatus. From 3 to 4 liters of air were allowed to pass through per hour. As soon as 100 liters had passed through the apparatus the absorption tube containing the sulphuric acid was removed, and the sulphuric acid was thoroughly washed from the absorption tube. This acid solution containing the lead emanations was evaporated to dryness, leaving the lead in the form of lead sulphate. The dry residue was treated with a solution of sodium hypochlorite, which reduced the lead sulphate to lead peroxide. The chlorine was removed by calcination or washing. On adding the Trillat reagent directly to the residue of lead peroxide there was obtained a characteristic blue color, which was determined colorimetrically by comparison of intensity of color with similar color produced by known amount of lead peroxide likewise treated. Traces of manganese and copper gave similar color reaction, but these were removed from the lead sulphate by washing.

"Through this procedure, Heim and Hébert studied first the emanations given off from 10 grams of metallic lead filings mixed with 150 grams of emery, and they obtained 0.5 and 1 milligram of lead as emanations per 100 liters of air, at temperatures of 18° and 100°, respectively. The same quantity of pure lead and solder or type alloy in fusion showed, respectively, 0.4 and 0.3 milligram of lead emanation per 100 liters of air. The results of these experiments showed that lead filings heated to 18° and 100° gave off more emanations than the molten pure lead, solder, and type alloy.

"In other experiments in which they used 100 grams of ground emery and a quantity of white lead corresponding to 10 grams of metallic lead, Heim and Hébert obtained the following results, at a temperature of 15° to 20°—namely, 0.15, 0.20, and 0.12 milligram of lead per 100 liters of air. These investigators concluded that their experiments verified those of Breton.

"PRELIMINARY EXPERIMENTS.

"As a preliminary to the determination of emanations from the lead glazes, it was necessary, since neither of the procedures described by Breton and by Heim and Hébert, was sufficient in detail to permit exact repetition of these experiments, to conduct a few experiments in order to ascertain the exact conditions which must exist in order to reduce the lead su.phate completely to lead peroxide, and also to remove all traces of oxidizing agents, such as chlorine, ozone, etc., derived from the sodium hypochlorite solution, after acidifying.

"In the first experiment portions of prepared lead sulphate were treated with sodium hypochlorite, first without heating, and secondly by boiling; but neither of these processes reduced the lead sulphate to peroxide. In subsequent experiments the sodium hypochlorite solution which was added to the lead sulphate was heated nearly to boiling. This procedure brought about the proper reduction of lead sulphate to peroxide.

"The experiments next conducted were to determine the treatment that must be followed in order to remove all oxidizing agents given off from sodium hypochlorite when acidified, since these gases also produced a blue color with Trillat's reagent. When the lead sulphate had been reduced to lead peroxide, after the procedure just described, the remaining sodium-hypochlorite solution was acidified with nitric acid. This acid solution was then filtered and the residue was washed until the filtrate was free from chlorides and acid. Considerable washing was required in order to remove all compounds which gave a blue color with the Trillat reagent, except the lead peroxide. The residue on the filter paper was then dissolved in acetic acid and tested with the Trillat reagent.

"Having finally worked out a procedure which would give somewhat dependable results, the following method of analysis was adopted:

"*Apparatus.*—The apparatus consisted of a series of absorption tubes, one Erlenmeyer flask, and a gas meter, connected with glass tubing in such a manner as to permit a known amount of air to be drawn through the apparatus.

"The air was first passed through two absorption tubes—one of which contained sulphuric acid, while the other contained caustic potash—thus removing any acid or basic vapor that might be present in the atmosphere; from these absorption tubes the air was led into a stoppered Erlenmeyer flask (1,000 c. c. capacity) to within 1 inch of the bottom, so as not to come in contact with the lead glaze which was in this flask; the air was then drawn from the Erlenmeyer flask through a U-tube filled with cotton batting, which served to prevent the escape of any dust from the sample of lead glaze; the air was then passed through a Geissler absorption bulb containing 10 c. c. of concentrated sulphuric acid, which dissolved the emanation of lead glazes; finally the air passed through a gas meter, which enabled the measurement of the flow of air through the apparatus.

"*Method.*—An amount of the lead glaze equivalent to 10 grams of metallic lead was weighed out and placed in the Erlenmeyer flask. Before the apparatus which has been just described was put in connection, the Erlenmeyer flask was rotated so as to spread the glaze over the entire interior surface of the flask. After a tight connection on the apparatus had been made the air was permitted to flow over the lead glaze at a rate of 6 liters an hour for a period of 24 hours. At the end of this time the Geissler bulb containing the sulphuric acid was disconnected, and the acid was thoroughly removed from the bulb to an evaporating dish, with water. The acid solution, which was evaporated to dryness, was treated with 20 c. c. of sodium-hypochlorite solution heated nearly to boiling point. This solution was then acidfied with nitric acid and filtrated. The residue on the filter paper was thoroughly washed until filtrate was free of chlorides and acid. The lead peroxide on the filter paper was dissolved in a small amount of acetic acid and tested with Trillat's reagent. The productions of a blue color indicated lead peroxide.

EXPERIMENTAL DATA.

Experiment No. 1 (lead glaze No. 16).

Per cent of water present		43.31
Per cent of total lead present		7.88
Per cent of soluble lead present		6.09
Weight of sample taken	grams	12.69
Volume of air aspirated per 24 hours	liters	144.00
Temperature of air during period of experiment	degrees	18–22
Amount of lead emanations obtained		None.

Experiment No. 2 (lead glaze No. 19).

Per cent of water present		35.34
Percent of total lead present		14.40
Per cent of soluble lead present		13.01
Weight of sample taken	grams	69.50
Volume of air aspirated per 24 hours	liters	144.00
Temperature of air during period of experiment	degrees	18–22
Amount of lead emanations obtained		None.

Experiment No. 3 (lead glaze No. 39).

Per cent of water present		0.62
Per cent of total lead present		17.85
Per cent of soluble lead present		9.77
Weight of sample taken	grams	56.02
Volume of air aspirated per 24 hours	liters	144.00
Temperature of air during period of experiment	degrees	18–23
Amount of lead emanations obtained		None.

Experiment No. 4 (lead glaze No. 41–a).

Per cent of water present		30.17
Per cent of total lead present		26.67
Per cent of soluble lead present		None.
Weight of sample taken	grams	37.50
Volume of air aspirated during 24 hours	liters	144.00
Temperature of air during period of experiment	degrees	20–22
Amount of lead emanations obtained		None.

Experiment No. 5 (lead glaze No. 41–b).

Per cent of water present		43.68
Per cent of total lead present		25.49
Per cent of soluble lead present		23.47
Weight of sample taken	grams	39.20
Volume of air aspirated during 24 hours	liters	144.00
Temperature of air during period of experiment	degrees	20–23
Amount of lead emanations obtained		None.

“DISCUSSION.

“The oxidizing agents, such as chlorine and ozone, which were liberated from the sodium hypochlorite and lead peroxide by the addition of nitric acid, were entirely separated from the remaining lead peroxide by filtration, followed by a thorough washing until the filtration was free of chlorine and acid. As a check on the complete removal of these oxidizing agents, there were run each time control experiments, using 20 c. c. of sodium hypochlorite with and without 0.2 milligram of lead sulphate, which is the compound of lead obtained by evaporating the sulphuric acid, if there were any emanations given off from lead glazes. In each of the five experiments conducted to determine the emanations from lead glazes the final test with the Trillat reagent was negative, agreeing exactly each time with the test made of the blank experiments. But in the experiments where 0.2 milligram of lead sulphate was treated with the sodium hypochlorite solution and the resulting lead peroxide was filtered and washed free of oxidizing agents, such as chlorine and ozone, there was obtained each time a positive test for lead peroxide, indicated by the distinct blue color produced with the Trillat reagent.

"The absence of emanations from lead glazes might be accounted for by the fact that some glazes were mixed with 30 to 43 per cent of water, which would tend to prevent any emanations. Yet this is hardly true, for in most of the experiments the water evaporated during the aeration period. Even in the cases where the water evaporated, there were present no indications of emanations. The results of these experiments agreed with those obtained by Experiment No. 3, in which was used a glaze containing 0.62 per cent of water.

"Furthermore, the absence of emanations in these experiments, as shown by chemical detection with Trillat's reagent—i. e., 5 per cent acetic acid solution of tetramethyl-diamino—dyphenylmethane—agreed with the results of Trillat, Bezancon, and Gautier (loc. cit.), although it disagreed with the results obtained by Breton and Heim and Hébert (loc. cit.), in spite of the fact that the technique followed was nearly identical with that stated to have been used by the latter investigators. In the method followed by Heim and Hébert it was stated that the chlorine was removed from the lead peroxide and the sodium hypochlorite solution by calcination or by washing with water. Both these procedures were found to be impracticable. Calcination and boiling, if sufficient to remove the chlorine, destroyed the lead peroxide, while the removal of the chlorine by washing was found to be practically impossible, since in the effort to remove the last traces of chlorine from such small amounts of lead peroxide as 0.1 to 0.2 milligram and also to free the interior of the beaker of adhering hypochlorite and free chlorine, the lead compound was lost by suspension in the wash water. Unless all the chlorine and hypochlorite were removed from the beaker, the Trillat reagent would turn blue in the absence of lead peroxide because of the chlorine gas set free from the hypochlorite by its acidifying with acetic acid contained in the Trillat reagent. In addition to the chlorine gas, which produced a blue color with the Trillat reagent, traces of ozone would also be present, which would likewise produce a blue color, according to the results stated by Arnold and Mentzel (7), and Fischer and Marx (8). The ability of Trillat's reagent to detect oxidizing agents as well as lead peroxide rather offsets its use as a reliable test for lead, especially where such small amounts of lead peroxide and gases were present.

"CONCLUSIONS.

"1. There were no emanations given off from the five lead glazes that were studied.

"2. The Trillat reagent, which was used for the detection of lead peroxide, was found to be extremely sensitive likewise to such oxidizing agents as chlorine and ozone.

"3. Unquestionable detection of lead emanations as lead peroxide from lead compounds must absolutely be determined in the absence of chlorine and ozone, if Trillat's reagent is used for the detection."

The above conclusions by Harry W. Houghton indicate that no lead hazard exists from emanations arising from tubs filled with glaze.

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APPENDIX D.

In this table the 92 potteries are arrayed in order of the rate of positive and presumptive plumbism, that having the highest rate being at the top. In the first column is given the approximate number of employees, in the second the average number of years of exposure of those employed in the glaze department, and in the third the average per cent of lead used in the glaze samples collected from the plant.

In the remaining columns there are enumerated certain undesirable plant conditions. The conditions found in the several plants are indicated by a star in the appropriate column. The total number of these conditions found in any plant is given in the last column.

This array is divided into three groups of about an equal number of plants, and column totals or averages are given for each group.

Thus, the average number employed in the upper group is 221, in the middle group it is 180, and in the lower group it is 138. The upper group has an average of 15.1 of these undesirable conditions; the middle group, of 11.8, and the lower group, of 9.6.

Undesirable plant conditions for 92 potteries, arranged in the order of rate of positive and presumptive plumbism.

Approximate number of employees.	Average number of years of exposure.	Per cent of soluble lead used in glaze.	Bad toilets.	Common drinking cup.	Open water pail.	Dirty ware board.	Expectorations on the floor.	Dust 200,000 particles.	Poor illumination.	Piecework.	Eat in workroom.	No bathing facilities.	Poor wash facilities.	Poor ventilation.	Splash about tubs.	Dry sweeping.	Sweep during work hours.	Use soft coal.	Open glaze containers.	No respirators.	No special clothing.	No instruction.	No lockers.	No soap and towels.	Pronounced.				Total.
																									Cold hazard.	Heat hazard.	Wet hazard.	Fatigue hazard.	
130	13.0	12.8	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	25
100	14.0	13.3	*	*	*	*		*	*	*	*	*	*		*	*				*		*	*	*			*		17
150	13.7	15.6		*		*	*	*	*	*	*	*	*				*			*	*		*	*				*	15
100	15.0	13.9	*	*			*		*	*	*	*	*	*	*		*			*	*		*	*	*		*	*	18
130	11.9	13.7		*	*		*	*	*	*	*	*	*		*		*			*	*		*	*			*	*	17
25	5.0	45.7	*	*		*			*	*	*	*	*	*		*	*			*		*	*						14
365	12.4	13.1	*	*	*	*	*	*	*	*	*	*	*			*			*	*		*	*	*					17
625	12.2	13.3	*	*	*	*		*	*	*	*	*	*	*			*			*		*	*	*				*	17
200	12.4	14.2	*	*			*		*	*	*	*	*		*	*				*	*		*	*				*	15
225	13.3	13.0	*	*		*	*	*	*	*		*	*		*		*				*	*	*	*					15
90	13.8	12.6	*	*		*	*	*	*	*	*	*	*	*	*		*			*	*		*	*				*	18
390	8.6	13.4	*	*		*		*	*	*	*	*	*	*	*	*					*	*	*	*					16
300	12.8	12.3	*	*	*		*			*	*	*					*			*	*		*	*				*	13
125	6.0	13.8	*	*			*		*	*	*	*	*	*	*	*	*			*	*		*	*				*	17
125	10.0	12.6	*	*	*		*		*	*	*	*	*		*		*		*	*			*	*				*	16
275	6.8	12.4		*			*	*	*			*		*	*					*	*	*		*					11
400	7.9	12.3		*	*	*	*		*	*	*	*			*						*		*	*				*	13
800	12.0	12.3	*	*	*	*	*		*	*	*	*			*		*			*	*		*	*				*	16
230	16.6	19.2	*	*			*		*		*	*			*		*			*	*		*	*				*	13
70	13.3	16.0	*	*					*	*	*	*	*		*	*			*			*	*	*				*	14
80	5.9	16.3	*	*	*		*	*			*	*		*	*	*	*						*	*					13
110	9.8	10.8		*			*	*	*	*	*	*			*						*	*		*					11
75	12.4	11.6	*			*	*	*	*	*	*	*			*	*					*		*	*	*	*		*	16
610	8.5	12.0	*	*		*	*	*			*	*	*		*	*			*	*		*	*	*					15
375	10.9	3.1		*		*	*	*		*	*	*			*		*			*		*			*	*			13
700	10.6	13.7			*		*	*	*	*	*	*		*	*		*							*				*	12
90	3.1	14.7	*	*			*	*	*	*	*	*	*		*		*			*			*	*					14
200	8.1	15.5	*	*	*		*	*		*	*	*	*		*		*				*		*	*				*	15
230	11.3	14.5	*	*	*		*			*	*			*	*		*			*	*		*	*				*	14
275	7.2	14.4		*	*		*			*	*	*	*		*		*			*	*		*	*				*	14
100	10.6	10.2	*			*	*		*	*	*	*	*		*		*	*				*	*	*					14
[1] 221	[1] 12.6	[1] 14.3	23	28	14	15	26	18	24	27	29	30	20	11	26	11	21	2	5	21	19	13	27	29	4	2	4	19	[1] 15

[1] Average for group.

Undesirable plant conditions for 92 potteries, arranged in the order of rate of positive and presumptive plumbism—Continued.

Approximate number of employees.	Average number of years of exposure.	Per cent of soluble lead used in glaze.	Bad toilets.	Common drinking cup.	Open water pail.	Dirty ware board.	Expectorations on the floor.	Dust 200,000 particles.	Poor illumination.	Piecework.	Eat in workroom.	No bathing facilities.	Poor wash facilities.	Poor ventilation.	Splash about tubs.	Dry sweeping.	Sweep during work hours.	Use soft coal.	Open glaze containers.	No respirators.	No special clothing.	No instruction.	No lockers.	No soap and towels.	Pronounced.				Total.
																									Cold hazard.	Heat hazard.	Wet hazard.	Fatigue hazard.	
140	16.8	14.6		*		*		*	*	*	*	*		*		*			*			*	*	*					13
135	10.8	12.8	*	*		*	*		*	*		*			*	*					*	*	*	*					13
150	11.4	12.3	*	*	*		*		*	*	*	*	*				*			*	*		*	*				*	13
60	15.3	No.						*		*	*	*									*		*	*					7
120	15.4	9.2		*	*		*	*	*	*		*			*		*		*		*	*	*	*				*	15
220	10.8	9.2	*	*	*		*	*	*	*	*				*		*			*		*	*	*					14
185	10.6	13.3		*	*	*	*	*	*	*	*	*	*			*	*					*	*	*					15
65	11.5	13.9	*	*			*	*	*		*	*	*		*		*			*	*		*	*				*	15
65	10.2	27.9		*			*	*	*	*		*	*				*			*	*		*	*					12
110	15.2	10.6	*	*		*		*	*	*	*				*		*				*		*	*					12
225	7.6	14.2		*		*	*	*		*		*	*							*	*		*	*					11
185	7.4	10.3	*	*	*		*	*	*	*	*	*			*							*	*	*					13
275	12.0	10.6		*	*		*	*			*	*	*		*		*			*	*		*	*				*	15
200	9.3	8.3					*	*							*		*				*				*				6
50	7.9	21.8		*				*	*	*		*				*								*					7
230	3.0	13.9		*				*				*									*								4
205	5.1	28.7		*			*	*	*		*	*	*			*				*	*		*	*	*				13
155	6.0	27.9		*								*			*							*							4
350	2.7	12.3		*	*	*	*	*		*		*				*		*				*	*	*					12
125	2.4	8.7		*				*		*	*	*	*			*			*			*	*	*					11
200	9.1	9.8		*	*		*	*	*	*	*	*	*		*		*			*	*		*	*				*	16
150	9.4	13.9	*	*	*	*		*			*	*	*		*	*				*		*	*	*					14
120	16.5	No.				*	*	*	*			*			*							*		*					8
150	9.9	12.4		*	*		*		*	*	*	*	*		*		*			*	*		*	*				*	15
155	6.0	10.4	*	*			*	*		*	*		*		*	*				*		*	*	*					13
300	11.6	14.0		*	*		*	*		*	*	*	*	*	*		*				*		*	*				*	15
325	11.7	12.3		*	*		*			*	*	*					*			*	*		*	*					11
190	11.7	11.1	*	*	*	*		*	*		*	*	*									*	*	*					12
200	5.0	9.4		*	*		*	*		*	*	*			*		*				*		*	*					13
350	11.4	9.8		*			*	*			*	*				*	*					*	*	*					10
[1]180	[1]11.0	[1]13.7	9	27	14	9	21	25	16	21	20	26	14	2	16	10	15	1	3	12	17	14	25	27	2	..	..	7	[1]11.8
115	11.4	14.7		*			*	*	*	*		*					*				*			*				*	10
75	13.4	12.4		*	*		*	*		*	*		*		*							*		*					10
40	15.0	No.	*	*		*	*	*	*		*	*	*								*		*	*					12
70	10.0	No.	*	*	*		*			*	*	*	*		*		*						*	*					12
125	16.9	12.3	*	*	*		*		*	*	*	*	*	*	*		*			*	*		*	*				*	17
125	14.8	13.3	*	*	*		*	*		*	*	*	*		*	*	*			*			*	*				*	16
110	10.8	10.6		*			*			*	*					*	*												6
120	12.6	15.4		*		*	*					*	*		*	*	*							*				*	10
120	12.9	20.4		*		*	*			*	*	*	*		*								*	*					10
135	5.4	9.8	*	*			*		*			*	*		*					*	*		*	*				*	12
120	10.2	9.2		*					*	*										*				*					5
65	14.8	15.7					*	*		*		*			*						*	*		*					8
175	6.9	12.0	*	*	*	*				*	*	*	*									*	*	*					11
125	7.7	5.6						*				*								*	*		*	*					6
115	10.3	11.0		*			*		*		*	*	*							*	*		*	*				*	11
175	9.3	14.0	*				*			*	*				*		*			*	*		*	*					10
150	8.8	18.9		*	*		*	*		*		*					*			*	*		*	*				*	12
225	7.3	11.7		*			*	*		*		*			*					*	*		*	*					10
135	5.7	11.4					*	*			*				*		*	*					*	*					8
450	7.2	4.8									*	*					*			*	*			*					6
25	9.2	20.1		*		*	*			*			*		*	*	*						*	*					10
80	11.7	18.5		*			*			*												*							4
105	11.9	No.	*	*				*		*																			4
30	12.4	10.6	*	*			*	*	*	*			*		*						*		*						10
95	11.4	13.6		*			*	*	*	*					*						*	*		*					9
120	8.8	16.7		*						*																			2
125	10.3	13.1		*	*		*		*	*	*										*		*	*					9
140	9.3	14.8		*	*						*	*	*		*							*	*	*					9
260	3.7	7.4		*				*	*	*		*									*		*	*					8
225	8.4	12.9	*	*	*					*	*	*	*		*							*	*	*					11
200	10.1	.3	*	*	*			*		*	*	*			*							*	*						10
[1]134	[1]9.3	[1]12.5	11	26	10	5	21	14	10	23	16	19	14	1	17	4	11	1	....	10	15	8	20	25	..	..	..	7	[1]9.6

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[1] Average for group.

APPENDIX E.

DUST.

The dust samples are given according to the dipping, glaze-mixing, and glost-kiln rooms of the pottery plants.

The tables show the number of particles of each class, the weight of all solids in the sample, and the divisions of this solid material. The last two columns in the tables show the total amounts inhaled daily, based on the accepted fact that 135 cubic feet of air is the average amount of inhaled air per accepted workday for each adult exposed to these dusts.

METHODS OF COLLECTING DUST SAMPLES.

All dust counts in the survey were based on the number of dust particles per cubic foot. The technique used closely followed that worked out by Palmer, Coleman, and Ward. (Report of Committee on Standard Methods of the Examination of Air, American Public Health Journal, Vol. VII, 1917.) Our methods have already been described in Part I of the report.

The following tables were made on the basis outlined:

Number of dust particles in each class, weight of solids, and number of dust particles and amount of soluble lead inhaled per workday.

DIPPING ROOM.

Sample No.	Number of particles per cubic foot.					Weight per cubic foot of air (milligrams).			Per cent of lead.	Per cent of soluble lead.	135 cubic feet of air breathed per day.	
	Class 1.	Class 2.	Class 3.	Class 4.	Total.	Total.	Lead.	Soluble lead.			Number of particles.	Amount of soluble lead (milligrams).
SANITARY WARE.												
1			22,000	693,300	715,300	0.258	0.0252	0.0227	9	8.8	96,565,500	3.0645
2			25,000	1,695,000	1,720,000	.090	.0103	.0103	11.4	11.4	232,200,000	1.39
3			6,800	351,100	357,900	.0904	.0128	.0128	14.2	14.2	48,316,500	1.728
4			5,300	596,700	602,000	.116	.0144	.0144	12.4	12.4	81,270,000	1.944
5				152,000	152,000						20,520	
6			4,400	118,200	122,600	.0133	.001	.001	7.8	7.8	16,551,000	.135
7			16,500	1,651,200	1,667,700	.104	.0092	.0092	8.8	8.8	225,139,500	1.242
8			440,000	98,300,000	98,740,000	.142	.0071	.0071	5	5	13,329,900,000	.9585
9			600	176,000	176,600	.078	.01	.0099	12.9	12.8	23,841,000	1.3365
10				61,000	61,000	.08	.005	.005	6.2	6.2	8,235,000	.675
11			1,000	286,000	287,000	.036	.022	.022	60.5	60.5	38,745,000	.297
12			7,000	248,000	255,000	.034	.022	.022	64.7	64.7	34,425,000	.297
13		1,200	23,600	1,140,000	1,164,800	.114	.0036		3.15		157,248,000	
14			12,000	2,126,000	2,138,000	.114	.0012		1.05		288,630,000	
15			8,400	1,916,000	1,924,400	.110	.0075		6.82		259,794,000	
16			16,000	307,000	323,000	.092	.015	.015	16.3	16.3	43,605,000	2.025
17			12,000	320,000	332,000	.126	.01	.01	7.93	7.93	44,820,000	1.35
18			6,000	156,000	162,000	.069	.008	.008	11.5	11.5	21,870,000	1.08
19			5,000	539,000	544,000	.088	.024	.024	27.2	27.2	73,440,000	3.24
20			16,000	256,000	272,000	.131	.015	.015	11.45	11.4	36,720,000	2.025
21			2,000	268,000	270,000	.068	.044	.044	64.8	64.8	36,450,000	5.94
22			3,000	213,000	216,000	.048	.022	.022	45.3	45.3	29,160,000	2.97
23			2,030,000	99,600,000	101,630,000	.082	.0010		1.2		13,720,050,000	
24			600,000	61,200,000	61,800,000	.078	.0012		1.6		834,300,000	
25			6,000	256,000	262,000	.053	.015	.015	28.1	28.1	35,420,000	2.025

26.			6,000	230,000	236,000	.131	.015	.015	11.46	11.46	31,860,000	2.025
27.			10,000	230,000	240,000	.155	.015	.015	9.66	9.6	32,400,000	2.025
28.			7,000	187,000	194,000	.116	.01	.01	8.59	8.59	26,190,000	1.35
29.			8,000	207,000	215,000	.061	.013	.013	21.45	21.3	29,160,000	1.755
30.			10,000	346,000	356,000	.208	.015	.015	7.2	7.2	46,925,000	2.025
31.			41,000	517,000	559,000	.156	.011	.011	7.1	7	75,465,000	1.485
GENERAL WARE.												
32.			140,000	15,960,000	16,100,000	.707	.0009	.0009	.1	.1	2,173,500,000	.1215
33.			6,300	192,000	198.800	.025	.0011	.0011	4.4	4.4	26,838,000	.1485
34.			112,000	18,875,000	18,987,000	.639	.116	.116	18.2	18.2	2,863,245,000	15.66
35.			1,100	36,200	37,300	.0044	.0006	.0006	12.5	12.5	6,527.500	.810
36.			32,000	1,677,300	1,709,300	.0887	.0041	.0041	4.6	4.6	230,745,500	.5535
37.			7,200	237,100,000	244,300	.0222	.0009	.0009	4	4	32,980,500	.1215
38.			58,600	1,076,800	1,135,400	.109	.0053	.0053	4.9	4.9	153,279,000	.7155
39.			....	....	....	.0228	.0069	.0069	30.2	30.2	....	.9315
40.			....	....	....	.074	.0035	.0035	5	5	....	.4725
41.			8,900	1,109,000	1,117,900	.040	....	....	....	....	150,916,500	....
42.			91,000	8,225,000	8,316,000	.37	.034	.034	9.2	9.2	1,122,660,000	4.59
43.			6,000	202,000	208,000	.107	.0024	.0024	2.2	2.2	28,080,000	.3240
44.			7,500	89,500	97,000	.0378	.0022	.0018	5.9	4.9	13,095,000	.243
45.			2,000	48,100	50,100	.0263	.0036	.0025	12.7	8.8	6,763,500	.3375
46.			28,000	2,415,500	2,443,500	.095	.0069	.0069	7.3	7.3	329,872,500	.9315
47.			48,000	1,872,000	1,920,000	.155	.0082	.0082	5.3	5.3	259,200,000	1.107
48.			5,800	237,400	243,200	.0627	.0103	.0103	12.4	12.4	32,832,000	1.3905
49.			69,300	1,597,000	1,666,300	.0713	.0068	.0068	9.5	9.5	224,950,500	.918
50.			22,000	1,553,000	1,575,000	.132	.0057	.0057	4.3	4.3	212,625,000	.7695
51.			8,800	1,138,000	1,146,800	.138	.0069	.0089	6.5	6.5	154,718,000	1.2015
52.			2,800	294,400	297,200	.276	.0122	.0122	4.4	4.4	40,122,000	1.647
53.			....	....	....	.0322	.0083	.0083	25.7	25.7	....	1.1205
54.			....	....	....	.0317	.0028	.0028	8.9	6.1	....	.378
55.			11,600	1,126,000	1,137,600	.075	.0188	.0186	25.1	24.8	153,576,000	2.511
56.			15,600	291,100	306,700	.025	.0004	.0004	1.8	1.8	41,504,500	.054
57.			2,400	68,800	71,200	.023	.0013	.0013	5.7	5.7	9,612,000	.1755
58.			1,700	67,500	69,200	.0075	.0008	.0008	10	10	9,342,000	.108
59.			6,400	686,600	693,000	.0716	.0054	.005	7.5	7	93,555,000	.675
60.			5,600	520,800	526,400	.0541	.0064	.0057	11.9	10.5	71,064,000	.7695
61.			95,200	3,485,700	3,580,900	.562	.0362	.0329	6.4	5.8	473,421,500	4.44
62.			10,400	1,380,000	1,390,400	.138	.009	.009	6.5	6.5	187,704,000	1.215
63.			35,500	1,324,400	1,359,900	.316	.0253	.0253	8	8	183,586,500	3.4155
64.			17,100	243,200	260,300	.0467	.003	.003	6.5	6.5	35,140,500	.405
65.			18,700	159,000	177,700	.0707	.0021	.0021	8	3	23,989,500	.2835
66.			5,700	871,700	877,400	.0563	.0065	.0061	11.5	10.9	118,449,000	.8235

Number of dust particles in each class, weight of solids, and number of dust particles and amount of soluble lead inhaled per workday—Continued.

DIPPING ROOM—Continued.

Sample No.	Number of particles per cubic foot.					Weight per cubic foot of air (milligrams).			Per cent of lead.	Per cent of soluble lead.	135 cubic feet of air breathed per day.	
	Class 1.	Class 2.	Class 3.	Class 4.	Total.	Total.	Lead.	Soluble lead.			Number of particles.	Amount of soluble lead (milligrams).
GENERAL WARE—contd.												
67	.....	.....	4,900	856,400	861,300	0.0667	0.0041	0.0041	6.2	6.2	116,275,500	0.5535
68	.....	.....	77,700	4,155,500	4,233,200	.8861	.0794	.0794	9.2	9.2	571,482,000	10.719
69	.....	.....	210,000	10,090,000	10,300,000	.0756	.0067	.0067	8.8	8.8	1,390,500,000	.9045
70	.....	.....	107,000	5,340,000	5,447,000	.0281	.0012	.0012	4.2	4.2	735,345,000	.162
71	.....	.....	32,000	2,616,000	2,648,000	.412	.0096	.0096	2.3	2.3	357,480,000	1.296
72	.....	.....	6,800	520,000	526,800	.124	.0046	.0046	3.7	3.7	131,118,000	.6210
73	.....	.....	3,800	731,400	735,200	.138	.0133	.0133	9.7	9.7	99,252,000	1.7955
74	.....	.....	3,200	21,600	24,800	.0407	.0012	.0012	2.9	2.9	3,348,000	.162
75	.....	.....	79,200	165,000	194,200	.0541	.0048	.0048	8.9	8.9	26,216,000	.648
76	.....	.....	36,000	312,800	348,800	.252	.0188	.0188	7.4	7.4	47,088,000	2.538
77	.....	.....	6,500	342,500	349,000	.0296	.0008	.0008	2.8	2.8	47,115,000	.108
78	.....	.....	6,200	261,900	268,100	.0437	.0012	.0008	2.7	1.9	36,193,500	.108
79	.....	.....	6,600	396,000	402,600	.0409	.0031	.0027	7.5	6.5	54,351,000	.3645
80	.....	.....	12,200	1,940,000	1,952,200	.114	.0095	.0083	8.3	7.3	263,547,000	1.12
81	.....	.....	7,200	1,132,000	1,139,000	.102	.0026	.....	2.5	.....	153,765,000	.....
82	.....	.....	680,000	206,000,000	206,680,000	.152	.0075	.....	.....	.....	27,901,800,000	.....
83	.....	.....	8,000	28,000	36,000	.0625	.00205	.00206	3.307	3.3	44,860,000	.278
84	.....	.....	.....	5,050	5,050	.060	.....	.0061	.....	9	681,750	.8235
85	.....	.....	29,560	14,780	44,340	.132	.....	.0094	.....	7.1	5,985,900	1.269
86	.....	.....	2,640	2,640	5,280	.111	.....	.012	.....	10.8	712,800	1.62
87	.....	.....	.....	.....	.....	.08	.....	.056	.....	5.6	.....	7.56
88	.....	.....	12,460	28,050	40,510	.108	.....	.0046	.....	4.3	4,468,850	.621
89	.....	.....	.....	.....	.....	.093	.....	.0015	.....	1.6	.....	.2025
90	.....	.....	.....	.....	.....	.126	.....	.0043	.....	3.4	.....	.5805
91	.....	.....	720,000	116,000,000	116,720,000	.069	.0011	.....	1.2	.....	15,757,200,000	.....

92			450,000	67,500	517,500	.761		.0175		2.3	69,862,500	2.36
93						.186		.0041		2.2		.5535
94						.152		.0026		1.7		.351
95						.312		.0066		2.2		.891
96						.156		.0031		2		.4185
97						.133		.0025		1.9		.3375
98			6,894	380,583	386,477	.02	.0007	.00056		3.89	53,524,395	.0756
99			14,222	363,666	377,100		.0032	.0008			50,906,500	.108
100						.0156	.0007	.0005	4.53	3.73		.0675
101							.0022					
102						.0233	.0010	.0008	4.28	3.39		.108
103			18,364	126,090	144,454	.0288	.0002	.0001	0.78	0.47	19,501,290	.0135
104						.0307	.0008	.0003	2.65	1.08		.0405
105						.0086		.0004		5.26		.054
106			7,000	126,000	133,000	.093	.015	.015	16.2	16.1	17,955,000	2.025
107		500	6,000	320,000	326,000	.164	.053	.053	32.2	32.2	44,010,000	7.155
108			10,000	288,000	298,000	.19	.067	.067	35.5	35.5	40,230,000	9.045
109			15,000	257,000	272,000	.156	.028	.028	8.05	18	36,720,000	3.78
110			9,000	173,000	182,000	.082	.031	.031	37.8	37.8	24,570,000	4.185
111						.133	.038	.038	28.6	28.6		5.13
112			13,000	144,000	157,000	.102	.034	.034	33.2	33.2	21,195,000	4.59
113						.0022		.0003		14.29		.0405
114						.0250	.0007	.0006	2.83	2.33		.081
115			4,000	78,000	82,000	.086	.025	.025	29.1	29.1	11,070,000	3.375
116			11,000	227,000	238,000	.108	.011	.011	10.25	10.2	32,130,000	1.485
117			23,000	256,000	279,000	.111	.010	.00999	9.0	9	37,665,000	1.3486
118			26,000	428,000	454,000	.138	.044	4.4	32	31.9	61,290,000	5.94
119			10,000	309,000	319,000	.062	.008	.008	12.8	12.8	43,065,000	1.08
120			28,000	178,000	206,000	.106	.028	.028	26.4	26	27,810,000	3.78
121			7,000	56,000	63,000	.074	.027	.027	36.5	36	8,505,000	3,645
122			6,500	30,000	36,500	.057	.019	.019	33.25	33.2	4,927,500	2.565
123			19,000	382,000	401,000	.067	.081	.031	20.67	20.6	54,135,000	4.185
124			13,560	32,530	46,090	.084		.0033	3.9	3.9	6,222,150	.4455
125			230,620	435,620	666,240	.154		.006	3.9	3.9	89,942,400	.81
126			30,500	23,720	54,220	.175		.0037	2.1	2.1	7,319,700	.4995
127			20,330	20,330	40,660						5,489,100	
128			17,780	142,220	160,000						21,600,000	
129			410,000	86,400,000	86,810,000	.073	.0004		.5		89,848,350,000	
130			510,000	222,900,000	223,470,000	.088	.0005		.5		30,168,450,000	
131			1,040,000	176,000,000	177,040,000	.104	.0007		.7		23,900,400,000	
132			440,000	200,000,000	200,440,000	.077	.0006		.8		27,059,400	
133			1,600,000	369,000,000	370,600,000	.484	.0067		1.4		50,031,000,000	
134			440,000	108,000,000	108,440,000	.064	.001		1.6		14,639,400	
135			50,000	227,000	277,000	.229	.028	.0229	10	10	34,695,000	3.0915
136			26,000	137,000	163,000	.117	.013	.0129	11	11	22,006,000	1.7415

Number of dust particles in each class, weight of solids, and number of dust particles and amount of soluble lead inhaled per workday—Continued.

DIPPING ROOM—Continued.

Sample No.	Number of particles per cubic foot.					Weight per cubic foot of air (milligrams).			Per cent of lead.	Per cent of soluble lead.	135 cubic feet of air breathed per day.	
	Class 1.	Class 2.	Class 3.	Class 4.	Total.	Total.	Lead.	Soluble lead.			Number of particles.	Amount of soluble lead (milligrams).
GENERAL WARE—contd.												
137			47,000	377,000	424,000	0.113	0.016	0.0129	14.1	14.1	57,240,000	1.7415
138			1,100,000	14,300,000			.012					
139						.0425		.0025		5.88		.3375
140						.003	.0003	.00015	10	5		.02025
141						.0104	.0008	.0008	8	8		.108
142						.019	.0025	.0025	13.2	13.2		.3375
143						.0625	.0012	.0012	2.38	.2		.162
144						.0175		.0011		.17		.1485
145						.0558	.0038	.0038	6.94	6.94		.513
146						.0208		.00054		2.65		.0729
OTHER WARE.												
147			57,700	1,622,200	1,679,900	.164	.0129	.0123	7.8	7.5	226,786,500	1.66
148			6,400	336,000	342,400	.072	.0024	.0024	3.3	3.3	46,224,000	.324
149			11,000	422,000	433,000	.15	.042	.042	28	28	58,455,000	5.67
150			47,000	592,000	639,000	.289	.019	.019	6.57	6.5	87,265,000	2.565
151			35,000	523,000	558,000	.227	.014	.014	6.16	6.1	75,330,000	1.89
152			4,000	73,000	77,000	.042	.0083	.0083	19.9	19.8	10,395,000	1.12
153			22,000	352,000	374,000	.111	.015	.0149	13.5	13.5	50,490,000	2.01
154			9,000	200,000	209,000	.065	.01	.01	15.5	15.4	28,215,000	1.35
155			5,000	190,000	195,000	.06					26,325,000	
156			34,000	277,000	311,000	.113	.013	.013	11.47	11.4	41,985,000	1.755
157			22,000	133,000	155,000	.09	.008	.00792	9	8.8	20,925,000	1.0692
158			11,000	385,000	396,000	.112	.01	.01	8.92	.09	53,460,000	1.35
159			17,000	147,000	164,000	.109	.009	.009	8.81	8.2	22,140,000	1.215
160			25,000	390,000	415,000					.173	56,025,000	1.08
161			20,000	203,000	223,000	.14	.019	.019	13.5	13.5	30,105,000	2.565
162			88,000	228,000	316,000	.128	.008	.008	6.25	6.3	42,660,000	1.08
163			5,000	51,000	56,000	.083	.003	.003	9	9	7,560,000	.405

GLAZE-MIXING ROOM.

SANITARY WARE.													
164			14,500	177,900	192,400	0.0452	0.0005	0.0005	1.1	1.1	25,974,000	0.0675
165			59,000	2,331,000	2,390,000	.476	.242	.242	50.8	50.8	322,650,000	3.267
166			41,000	1,973,000	2,014,000	.318	.043	.043	13.51	13.5	27,189,000	5.805
167			168,000	2,887,000	3,055,000	1.164	.037	.037	3.4	3.2	412,425,000	4.995
168			24,000	2,652,000	2,676,000	.378	.06	.06	15.8	15.6	361,260,000	8.1
169			9,000	602,000	611,000	.16	.01	.01	6.25	6.2	82,485,000	1.35
GENERAL WARE.													
170			6,600	515,500	522,100	.0228	.0007	.0007	2.9	2.9	70,483,500	.0945
171			341,300	4,805,300	5,146,600	.549	.0005	.0005	.1	.1	180,131,000	.0675
172			8,900	969,000	977,900	.0311					130,801,500	
173			20,000	433,200	4,752,000	.206	.0228	.0228	11.1	11.1	641,520,000	3.078
174			5,800	666,000	671,800	.0844	.0007	.0007	.8	.8	90,693,000	.0945
175			400	140,400	140,800	.0968	.0262	.0262	27	27	19,008,000	3.537
176			22,400	4,416,800	4,439,200	.204	.0228	.0228	12.3	12.3	599,292,000	3.078
177			7,600	1,464,100	1,471,700	.125	.0108	.0097	8.6	7.7	198,679,500	1.3095
178			41,700	1,648,700	1,690,400	.291	.0710	.0710	24.6	24.4	228,204	9.585
179			18,800	321,200	340,000	.057	.0040	.0040	7	7	45,900,000	.54
180			42,500	931,500	974,000	.4704	.0211	.0207	4.5	4.4	131,490,000	2.7945
181			17,500	987,500	1,005,000	.209	.01	.01	4.8	4.8	135,675,000	1.35
182			66,600	8,022,200	8,088,800	1.026					1,091,988,000	.108
183			416,000	24,064,000	24,480,000	5.208	2.07	2.07	39.7	39.7	3,304,800,000	2.7945
184				59,090	59,090	.62		.0099		1.6	7,977,150	1.3365
185			31,430	51,070	82,500	.63		.0435		6.9	11,137,500	5.8725
186			3,270	58,800	62,070	.27		.0459		17	8,379,450	6.196
187			56,000	229,600	285,600	1.31		.0039		.3	38,556,000	.5265
188			26,670	240,000	266,670	1.397		.5937		42.5	36,000,450	8.0149
189			214,220	489,640	703,860	5.446		.0653		1.2	95,021,100	8.8155
190			127,910	22,240	150,150	.444		.0178		4	20,270,250	2.403
191			50,000	227,000	277,000	.229	.028	.0229	10	10	34,695,000	3.0915
192			26,000	137,000	163,000	.117	.013	.0129	11.1	11.1	22,005,000	1.7415
193			47,000	337,000	424,000	.113	.016	.0159	14.1	14.1	57,240,000	2.1465
194			1,100,000	14,300,000			.012					
195						.0062	.0012	.0012	4.76	4.76		.162
196						.0396	.0042	.0040	10.63	10.11		.54
197						.0191	.00075	.0005	3.91	2.61		.0675
198			6,000	1,222,000	1,228,000	.338	.044	.044	13	13	165,780,000	5.94
199			4,000	110,000	114,000	.064	.028	.021	31.2	33.3	15,390,000	2.835

Number of dust particles in each class, weight of solids, and number of dust particles and amount of soluble lead inhaled per workday—Continued.

GLAZE-MIXING ROOM—Continued.

Sample No.	Number of particles per cubic foot.					Weight per cubic foot of air (milligrams).			Per cent of lead.	Per cent of soluble lead.	135 cubic feet of air breathed per day.	
	Class 1.	Class 2.	Class 3.	Class 4.	Total.	Total.	Lead.	Soluble lead.			Number of particles.	Amount of soluble lead (milligrams).
GENERAL WARE—contd.												
200	....	....	18,000	633,000	651,000	0.207	0.071	0.071	34.2	34.2	87,885,000	9.585
201	....	....	13,000	144,000	157,000	.15	.034	.032	22	22	21,195,000	4.32
202	....	....	12,500	1,975,000	1,987,500	.625	.0875	.0875	14	14	268,312,500	11.8125
203	....	....	17,000	122,000	139,000	.119	.006	.006	5	5	18,765,000	.81
204	....	....	35,000	577,000	612,000	.196	.004	.004	2.04	2	82,620,000	.54
205	....	....	47,000	1,000,000	1,047,000	.648	.028	....	....	4.3	141,345,000	....
206	....	....	11,200	124,400	135,600	.0170	.0010	.0010	5.9	5.9	18,306,000	.135
207	....	....	5,000	190,000	195,000	.06	....	....	....	....	26,325,000	....
208	....	....	9,000	300,000	309,000	.198	.103	.103	52	52	41,715,000	13.9

KILN ROOM.

Sample No.	Class 1.	Class 2.	Class 3.	Class 4.	Total.	Total.	Lead.	Soluble lead.	Per cent of lead.	Per cent of soluble lead.	Number of particles.	Amount of soluble lead (milligrams).
SANITARY WARE.												
209	....	....	4,100	26,600	30,700	0.017	0.0004	0.0004	2.2	2.2	4,144,500	0.054
210	....	....	7,700	697,100	704,800	.0717	.0043	.0043	6	6	95,148,000	.5805
211	....	....	540,000	72,900,000	73,440,000	.1	.0007	.0007	.7	.7	9,914,400,000	.0945
212	....	....	54,000	775,000	829,000	.336	.013	.013	3.86	3.8	111,915,000	1.755
213	....	....	67,000	951,000	1,018,000	.51	.011	.011	2.16	2.1	137,430,000	1.485
214	....	....	21,000	1,122,000	1,143,000	.172	.11	.11	.64	.64	154,305,000	1.485
215	....	....	12,000	490,000	502,000	.073	.024	.024	33	32.9	67,770,000	3.24
216	....	....	14,800	2,007,600	2,021,800	.13	.0014	....	1.06	....	270,943,000	....
217	....	....	41,000	1,675,000	1,716,000	.544	.021	.021	4.22	3.8	231,660,000	2.885
218	....	....	7,000	248,000	255,000	.59	.011	.011	1.86	1.8	34,425,000	1.485

219	....	....	3,520,000	162,000,000	165,520,000	.227	.0036	....	1.5	....	22,345,200,000	....
220	....	....	21,000	367,000	388,000	.192	.01	.0099	5.22	5.2	52,390,000	1.33
221	....	....	4,000	353,000	357,000	.126	.0077	.007	5.56	5.5	48,195,000	.945
222	....	....	23,000	746,000	769,000	.176	.021	.021	11.9	11.9	103,815,000	2.835
223	....	....	19,000	546,000	565,000	.096	.008	.008	8.8	8.8	76,275,000	.108
224	....	....	4,000	144,000	148,000	.053	.005	.005	9.87	9.4	19,980,000	.675
225	....	....	13,000	590,000	603,000	.158	.015	.015	9.52	9.5	81,405,000	2.025
226	....	....	31,000	1,295,000	1,326,000	.638	.015	.0146	2.3	2.3	179,010,000	1.971
227	....	....	8,500	543,000	551,500	.245	.01	.01	4.08	4.1	74,452,500	1.35
228	....	....	16,000	471,000	487,000	.283	.013	.013	.046	.046	65,745,000	1.755
GENERAL WARE.												
229	....	....	75,930	49,130	125,000	.78	....	.0158	....	2	16,883,100	2.133
230	....	53,400	17,800	89,000	160,200	.1473	....	.0221	....	1.5	21,627,000	2.9835
231	....	....	192,000	384,000	576,000	.35	....	.0248	....	3.3	77,760,000	3.348
232	....	....	2,240,000	109,000,000	191,240,000	.096	.0006	....	.6	....	25,817,400,000	....
233	....	....	1,120,000	195,000,000	196,120,000	.089	.0006	....	.6	....	26,476,200,000	....
234	....	500	28,000	641,000	669,000	.171	.021	.021	13.50	12.3	90,315,000	2.835
235	....	....	23,000	409,000	432,000	.528	.019	.019	3.6	3.6	58,320,000	2.565
236	....	....	22,000	531,000	553,000	.12	.026	.026	21.7	21.7	74,655,000	3.51
237	....	....	22,000	1,298,000	1,320,000	.196	.018	.018	9	9	178,200,000	2.43
238	....	....	23,000	555,000	578,000	.114	.016	.016	14.8	14	78,030,000	2.16
239	....	....	58,000	3,440,000	3,498,000	.533	.009	.009	1.7	1.7	472,230,000	1.215
240	....	....	....	....	....	.0025	.00065	.0006	34	24	....	.081
241	....	....	....	....	....	.007	.0006	.00045	8.57	5.71	....	.06075
242	....	....	....	....	....	.0262	.0012	.0012	4.76	4.76	....	.162
243	....	....	....	....	....	.0396	.0042	.0040	10.63	10.11	....	.54
244	....	....	....	....	....	.0215	....	....	.00	.00	....	....
245	....	....	....	....	....	....	.0009	....	....	....	....	....
246	....	....	....	....	....	.0712	.0031	.0031	4.38	4.38	....	.4185
247	....	....	....	....	....	.0014	.0006	.0006	4.34	4.34	....	.081
248	....	....	....	....	....	.1	.0022	.0020	2.21	2	....	.27
249	....	....	....	....	....	.0176	.0014	.0013	8.3	7.55	....	.1755
250	....	....	....	....	....	.0887	.0029	.0026	3.22	2.93	....	.351
251	....	....	....	....	....	....	.0005	....	....	....	....	....
252	....	....	....	....	....	....	.0021	.0014	....	....	....	.189
253	....	....	11,800	853,300	865,100	.0711	.0024	.0024	3.3	3.3	116,788,500	.3240
254	....	....	15,500	1,440,000	1,455,500	.0594	.0023	.0023	3.8	3.8	196,492,500	.3105
255	....	....	10,600	3,760,000	3,770,600	.205	.0133	.0133	6.5	6.5	659,855,000	1.7955
256	....	....	20,000	398,300	418,300	.050	.0002	.0002	.3	.3	56,470,500	.027
257	....	....	22,400	583,100	605,500	.0539	.0007	.0007	1.2	1.2	81,742,500	.0945
258	....	....	72,000	2,432,000	2,504,000	.222	.0072	.0072	3.2	3.2	338,040,000	.972

Number of dust particles in each class, weight of solids, and number of dust particles and amount of soluble lead inhaled per workday—Continued.

KILN ROOM—Continued.

Sample No.	Number of particles per cubic foot.					Weight per cubic foot of air (milligrams).			Per cent of lead.	Per cent of soluble lead.	135 cubic feet of air breathed per day.	
	Class 1.	Class 2.	Class 3.	Class 4.	Total.	Total.	Lead.	Soluble lead.			Number of particles.	Amount of soluble lead (milligrams).
GENERAL WARE—contd.												
259	....	....	....	....	....	0.0322	0.0033	0.0031	10.2	9.8	....	0.4185
260	....	....	....	....	....	.0172	.0009	.0009	5.5	5.5	....	.1215
261	....	....	....	....	....	.101	.0069	.0069	6.6	6.8	....	.9315
262	....	....	3,000	128,400	131,400	.0239	.0034	.0034	14.2	14.2	17,739,000	.4590
263	....	....	3,000	124,000	127,000	.0328	.0041	.0041	12.5	12.5	17,145,000	.5535
264	....	....	156,000	12,148,000	12,304,000	.1206	.0013	.0013	.1	.1	1,661,040	.1755
265	....	....	4,600	62,200	66,800	.0183	.0023	.0011	12.7	6.1	9,018,000	.1485
266	....	....	4,800	202,100	206,900	.0547	.0027	.0027	4.9	4.9	28,031,500	.3645
267	....	....	1,000	153,800	154,800	.098	.0055	.0055	5.6	5.6	20,898,000	.7425
268	....	....	2,600	1,592,000	1,594,600	.0813	0055	.0055	6.7	6.7	215,271,000	.7425
269	....	....	36,000	4,760,000	4,796,000	.326	.0106	.0106	32.5	32.5	647,460,000	1.431
270	....	....	4,400	927,600	932,000	.101	.0008	.0008	.8	.8	125,820,000	.108
271	....	....	12,000	793,600	805,600	.0722	.0004	.0004	.6	.6	108,756,000	.054
272	....	....	16,000	609,000	625,000	.09	.0004	.0004	.5	.5	84,375,000	.054
273	....	....	6,600	713,500	719,900	.105	.0204	.0204	19.4	19.4	97,186,500	2.754
274	....	....	22,200	613,300	635,500	.0689	.0038	.0038	5.6	5.6	85,792,500	.513
275	....	....	12,000	1,656,000	1,668,000	.149	.0082	.0082	5.5	5.5	225,180,000	1.107
276	....	....	7,400	626,000	633,400	.0633	.0064	.0052	10.2	8.2	85,509,000	.7021
277	....	....	1,500	104,000	105,300	.0156	.0014	.0014	9.8	9.8	14,215,500	.189
278	....	....	9,800	306,000	315,800	.045	.0012	.0011	2.6	2.3	42,633,000	.1485
279	....	....	2,500	183,900	186,400	.0145	.0002	.0002	1.5	1.5	25,164,000	.027
280	....	....	26,300	1,936,800	1,963,100	.193	.0064	.0049	3.3	3.3	265,018,500	.6615
281	....	....	150,000	4,200,000	4,350,000	.613	.0317	.0288	5.2	4.7	587,250,000	3.888
282	....	....	14,400	1,352,800	1,367,200	.08	.0084	.0074	10.5	9.3	184,572,000	.999
283	....	....	56,000	1,549,300	1,605,300	.408	.0241	.0241	5.9	5.9	216,715,500	3.2535

284	....	....	21,300	648,500	669,800	.0733	.0009	.0009	1.2	1.2	90,423,000	.1215
285	....	....	11,200	48,400	59,600	.066	.0004	.0004	.6	.6	8,046,000	.054
286	....	....	7,600	553,200	560,800	.0410	.0031	.0031	6.6	6.6	75,708,000	.4185
287	....	....	25,400	3,542,800	3,568,200	.0190	.0059	.0059	30.8	30.8	481,707,000	.7965
288	....	....	29,600	1,059,200	1,088,800	.21	.0074	.0074	3.5	3.5	1,469,880	.999
289	....	....	10,000	24,800	234,800	.0393	.0015	.0015	3.8	3.8	31,698,000	.2025
290	....	....	17,700	734,800	752,500	.0926	.0039	.0039	4.2	4.2	101,587,500	.5265
291	....	....	76,300	1,440,000	1,516,300	.0664	.0040	.0040	6.	6.	204,700,500	.54
292	....	....	152,700	6,341,800	6,494,500	1.465	.0453	.0444	3.1	3.	876,757,500	5.994
293	....	....	2,900	25,400	28,300	.0192	.0002	.0002	1.2	1.2	3,820,500	.027
294	....	....	31,200	420,000	451,200	.182	.0048	.0048	2.6	2.6	60,012,000	.648
295	....	....	13,900	133,000	146,900	.0437	.0008	.0008	1.9	1.9	19,751,500	.108
296	....	....	5,600	436,700	442,300	.0541	.0016	.0013	3.	2.3	59,710,500	.1755
297	....	....	6,300	323,300	329,600	.0325	.0003	.0003	1.	1.	44,496,000	.0405
298	....	....	23,200	1,341,600	1,364,800	.222	.0018	.0018	.8	.8	184,248,000	.243
299	....	....	5,900	507,800	513,700	.039	.0008	.0008	1.9	1.	69,349,500	.108
300	....	....	30,000	172,000	1,202,000	.167	.0078	....	4.71	....	162,270,000	....
301	....	....	11,000	580,000	591,000	.105	.0028	....	2.65	....	79,785,000	....
302	....	....	1,440,000	249,000,000	250,440,000	.152	.0075	....	....	....	11,269,800,000	....
303	....	....	760,000	6,800,000	61,560,000	.096	.0026	....	....	....	8,310,600,000	....
304	....	....	12,340	24,680	37,020	.113	.0015	.00149	1.32	1.3	4,997,700	.201
305	....	....	12,340	24,680	37,020	.082	.008	.0008	.97	.9	4,997,700	1.08
306	....	....	6,880	36,120	43,000	.182	....	.0066	....	3.6	5,805,000	.891
307	....	....	58,750	117,500	176,250	.685	....	.0247	....	3.6	23,793,750	3.3245
308	....	....	1,640,000	260,000,000	261,640,000	.124	.0013	....	1.5	....	35,321,400,000	....
309	....	145,710	....	36,430	255,000	437,140	1.357	....	.0163	....	1.2	59,013,900	2.2
310	....	33,090	....	50,800	23,080	96,980	.171	....	.0067	....	3.9	13,092,300	.9045
311	....	....	....	7,550	11,330	18,880	.101	....	.0027	....	2.7	2,548,850	.3645
312	....	....	....	79,200	158,400	237,600	.355	....	.0067	....	1.2	32,076,000	.9045
313	....	....	....	....	....	....	.349	....	.0185	....	5.3	....	2.4975
314	....	....	....	....	....	....	.30	....	.0156	....	5.2	....	2.106
315	....	....	....	....	....	....	1.80	....	.0504	....	2.8	....	6.804
316	....	....	....	31,290	39,110	70,400	.078	....	.00437	....	5.6	9,504,000	.5899
317	....	....	....	33,600	48,550	85,860	.422	....	.0061	....	1.2	11,591,100	.6885
318	....	....	....	30,400	97,280	127,680	.18	....	.0069	....	3.3	17,236,800	.7965
319	....	....	....	3,550	53,250	56,800	.70	....	.0091	....	1.3	7,668,000	1.228
320	....	....	....	....	....	....	.0951	.0039	.0018	3.13	1.84	T.	.243
321	....	....	....	....	....	....	.0084	.0008	.0004	10.0	5.0	....	.054
322	....	....	....	23,000	409,000	432,000	.20	.025	.025	12.5	12.5	58,320,000	3.375
323	....	....	....	....	....	....	.0067	....	....	....	....	....	....
324	....	....	....	14,000	291,000	305,000	.177	.014	.014	7.9	7.8	41,175,000	1.89
325	....	....	....	63,000	170,000	233,000	.107	.027	.027	15.3	25.2	31,455,000	3.645
326	....	....	....	9,000	173,000	182,000	.08	.023	.023	28.75	28.7	24,570,000	3.105
327	....	....	....	14,000	329,000	343,000	.075	.023	.023	30.67	30.6	46,305,000	3.1
328	....	....	....	10,000	345,000	355,000	.21	.018	.018	8.73	8.7	47,925,000	2.43

Number of dust particles in each class, weight of solids, and number of dust particles and amount of soluble lead inhaled per workday—Continued.

KILN ROOM—Continued.

Sample No.	Number of particles per cubic foot.					Weight per cubic foot of air (milligrams).			Per cent of lead.	Per cent of soluble lead.	135 cubic feet of air breathed per day.	
	Class 1.	Class 2.	Class 3.	Class 4.	Total.	Total.	Lead.	Soluble lead.			Number of particles.	Amount of soluble lead (milligrams).
GENERAL WARE—contd.												
329	......	......	......	......	......	0.0185	0.0007	0.0005	3.59	2.90	......	0.0675
330	......	......	......	......	......	.0179	.0022	.0020	12.66	11.25	......	.27
331	......	......	7,000	551,000	558,000	.166	.012	.012	7.2	7.5	75,330,000	1.620
332	......	6,000	15,000	206,000	221,000	.198	.015	.015	7.57	7.3	29,916,000	2.025
333	......	......	20,000	443,050	463,000	.128	.005	.005	3.9	5.9	16,205,000	.6750
334	......	......	26,000	1,204,000	1,130,000	.325	.013	.013	4	4	152,550,000	1.755
335	......	......	26,000	443,000	469,000	.11	.01	.0099	9.09	9	63,315,000	1.3365
336	......	1,500	15,000	527,000	544,500	.222	.089	3.9	17.55	17.5	73,507,500	5.265
337	......	......	15,000	216,000	231,000	.128	.039	.039	30.5	30.5	31,185,000	5.265
OTHER WARE.												
338	......	......	66,600	760,000	826,600	.124	.0021	.0021	1.7	1.7	111,591,000	.2825
339	......	......	8,000	335,000	343,000	.167	.027	.027	16.2	16	46,305,000.	3.645
340	......	......	6,000	217,000	223,000	.067	.044	.044	66	65.7	30,105,000	5.94
341	......	......	5,000	190,000	195,000	.058	.007	.007	12.1	12.1	26,325,000	.945
342[1]	......	......	8,000	210,000	218,000	.0544	.00067	.00067	1.2	1.2	28,430,000	.09045
343	......	......	44,000	2,308,000	3,424,000	.16	.0139	.0139	8.7	8.7	462,240,090	1.8765
344	......	......	64,000	1,825,000	1,889,000	.205	.012	.012	5.8	5.8	255,015,000	1.62
345[2]	......	......	21,100	89,100	110,200	.074	.0011	.0011	1.6	1.6	14,877,000	.1485
346	......	......	16,830	24,040	37,870	.11	.0018	.00176	1.63	1.6	5,112,450	.2376

General dipping wareroom.

[2] Bisque wareroom.

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THE PHYSIOLOGY OF FATIGUE

PHYSICO-CHEMICAL MANIFESTATIONS OF FATIGUE IN THE BLOOD

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BY

ALBERT BAIRD HASTINGS
Assistant Sanitary Chemist
U. S. Public Health Service

PREPARED BY DIRECTION OF THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1921

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THE PHYSIOLOGY OF FATIGUE.[1]

PHYSICO-CHEMICAL MANIFESTATIONS OF FATIGUE IN THE BLOOD.

By ALBERT BAIRD HASTINGS.

INTRODUCTION.

Any investigation of the physiology of fatigue presumes a previous knowledge of the physiology of rest. Only to the extent that the latter is known can the former be understood. In other words, only those processes identified with life which have been quantitatively interpreted in terms of energetics are available for application to the study of the problem of physiological fatigue.

Physiological fatigue may be locally present in any tissue—glandular, connective, nervous, cardiac, vascular, muscular, or circulating—or generally present as a condition of the entire organism. The fatigue with which this paper deals may well be identified with any of the tissues named; but since these experiments were limited to the blood, the changes occurring in the blood itself, and the most prominent changes therein, resulting from activity of the muscular tissue will be primarily considered. Associated with increased muscular activity is altered activity of probably all of the other tissues of the organism. The new conditions in the blood will therefore be at least partially a resultant of changed conditions in any of the other tissues.

Brücke first presented the conception of the elementary organism as being the physiological unit. "We are to think of the cell as having a complexity of structure apart from the molecular structure of the organic compounds composing it; this complexity we may call organization." The physiologist cannot therefore subdivide his material beyond the stage of unitary organization. Ritter has said that "the cells are subordinate to organisms everywhere and always, whether unicellular or multicellular beings," are being considered. And Prof. Pike has written that the physiologist must never "leave out of mind the fact that in some way or another, he is dealing with the whole organism, and not with one part alone."

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Fatigue then is not a local or circumscribed phenomènon to be explained or understood by a simple hunt for some chemical individual. It is *fatigue* of the *organization* which must be studied and the subsequent development is an attempt, necessarily fragmentary, to appreciate what certain phases of the fatigue of the organization may imply.

Viewed as changed physico-chemical relationships.—Qualitatively the organism may be considered in all stages of activity from the minimum required for its normal maintenance to the maximum of which it is capable, from the smallest transformation of energy compatible with continued life to the greatest. In man, one usually regards this heightened activity, concomitant with muscular effort, as terminating in subjective fatigue. However, muscular effort, or heightened cellular activity may be regarded as a normal condition so long as coordination of all of the integrated parts of the organism obtains; but when the acceleration of processes has progressed to such a point that abnormal conditions appear, the condition known as fatigue is realized. These abnormal conditions may be recognized by the disturbance of any of the intimately interrelated physico-chemical relationships of the organism. In this category may be grouped changes in osmotic pressure, diffusion, ionization, the chemical and physical distribution of substances, permeability and electrical condition of boundary surfaces, surface tension, solubility.

These disturbances in physico-chemical relationships may variously be the result of a number of conditions such as an actual or relative depletion of the material normally employed as the source of energy of the active tissues without their adequate renewal, the accumulation of products of normal metabolism in excess of the concentration in which they ordinarily exist, or possibly the production of metabolic substances nòt ordinarily produced. On the question of what are the physico-chemical disturbances in the fatigued organism, little work has been done. On the question of what chemical transformations have occurred in fatigue much literature exists, but on the whole the knowledge of the intimate nature of the condition is fragmentary and disconnected. It is the purpose of this paper briefly to enumerate and correlate some of the facts now in our possession, and show by experiments how physico-chemical investigation may prove fruitful in considering the problem of fatigue.

Blackman pointed out the applicability of the principles of chemical mechanics to the slow reactions occurring in the organism. Here the law of mass action is fully as operative as in less complex systems. The control of the velocity of the many reactions is a matter of much importance and, among possible influencing factors, there may be mentioned the following: The amount of actively reacting substances present, the presence and concentration of catalysts, the temperatures at which the reactions occur.

Viewed as reduced efficiency of energy transformations.—Transformation of energy is characteristic of every living cell. This energy may be manifested as electric, radiant, chemical, mechanical, and heat energy. From the law of the conservation of energy, the total energy released from the system must equal the total put into the system. But the proportions of this energy appearing in the various possible forms at any one time vary according to the efficiency of the system. In so far as the amount of energy degraded to the form of heat is a minimum, there is a gain in mechanical efficiency for the organism. The mechanical efficiency of the system is that proportion of the total energy supplied to the system available for the performance of work. For purposes of life, the higher this mechanical efficiency is, the greater will be the ability of the organism to meet the exigencies of existence. When the organism is functioning in such a way that the ratio of useful energy to the energy supplied has the greatest value, the efficiency of the system is at its optimum. When the efficiency of the system fails, the organism is working under unfavorable conditions. This failure in the efficiency of the system is regarded as fatigue. It is important in this connection to appreciate that a condition of diminished efficiency may obtain in certain tissues or organs which may be compensated for by increased efficiency in other portions of the organism so that the efficiency of the system taken as a whole may not be noticeably diminished.

As an illustration, consider the case of a reversible chemical reaction, e. g., ethyl alcohol + acetic acid = ethyl acetate + water. Suppose that one starts with equivalent quantities of alcohol and acid, removing the ethyl acetate and water as rapidly as they are formed, and that the concentrations of alcohol and acid are maintained at their original values by continual renewal. Conditions would then be optimum for this reaction and it would progress at its maximum rate for the given conditions. Suppose however that the rate at which alcohol was supplied to the system did not keep pace with its utilization; then the maximum rate at the given physical conditions would not be maintained. Or suppose that the products of the reaction were not removed as rapidly as they were formed; then also would the rate of the reaction be retarded. Here then are examples of failure on the part of the system to operate under optimum conditions—examples of chemical fatigue.

On turning to a consideration of fatigue in the complex multicellular animal organism, one is confronted with a system in which unknown numbers of possible chemical reactions exist which are for the most part interdependent. If one alters the rate in one set of these, e. g., those involved in muscular contraction, all of the others may be influenced by this change. When one has so altered the rate in one set that it no longer operates at its optimum efficiency, the others can not be considered as unaffected by this change. In other words fatigue involving primarily one set of tissues can not be regarded as confined to that portion of the organism alone, but to a greater or less degree must be regarded as affecting all of the other parts of the system.

It is proper here to refer briefly to some outstanding observations made in regard to the organism undergoing muscular activity. These observations refer to: (*a*) the primary seat of energy transformation, the muscles; (*b*) the vehicle of supplies and waste removal, the blood; (*c*) the distributing mechanism, the cardio-vascular system; (*d*) the source of supply and means of waste removal, the respiratory, alimentary and excretory systems; and finally (*e*) the coordinating and regulating mechanism, the endocrine and nervous systems.

Muscular tissue.—Muscle transforms energy into work by its contraction. Keith Lucas enunciated the important conception of the "All or None" response of skeletal muscle fibers in 1909. Increasing the strength of stimuli brings into a state of contraction more and more fibers until the maximal number capable of contracting at any one time are brought into activity. According to this conception there are no graded degrees to which individual fibers respond, but each fiber if it contracts at all, contracts maximally irrespective of the strength of the stimulus. However, the maximal response of which the fiber is capable may vary from time to time. This conception has been recognized by Mines, who offered the following explanation of the mechanism.

Mines believed that acid liberated by the excitation, precedes and possibly causes the shortening of the fiber. He furthermore postulates an optimum hydrogen ion concentration for the activity of the tissues. The effect of increased production of acid on the activity of the tissues would therefore depend upon the degree to which the resulting hydrogen ion concentration approaches or deviates from this optimum value. This conception is of importance in an understanding of the condition known as "treppe" and the subsequent fatigue upon continued stimulation of skeletal muscle.

Of the various theories advanced to explain muscular contraction none is without objection. Engelmann's attempt to liken muscle fibers to a heat engine is without substantiation by facts. An explanation depending upon increased osmotic pressure was advocated by Pauli, Macdonald, Macdougall and Zuntz, and one on altered surface tension by Bernstein. Both of these have elements of plausibility. Roaf showed by experiment and calculations that the amount of shortening observed in muscle fibers, the time involved in their contraction, and the force with which they contract can be accounted for on the assumption that lactic acid, produced in the isotropic substance, diffuses into the anisotropic substance, there combines with protein which then ionizes and leads to an increased osmotic pressure. He made the further suggestion that the formation of acids might alter the electrical condition of the surface of the fibrils and thus alter their surface tension in accordance with Bernstein's hypothesis. Wacker has lately pointed out that hydrogen ion determinations indicate that free acid can not exist in muscle, so that a hypothesis depending upon the swelling of protein in lactic acid is untenable. The recent work of Loeb on the correlation of the properties of proteins with their hydrogen ion concentrations may be useful in reconciling these opposing theories regarding the intimate nature of muscular contraction.

Whatever hypothesis proves to be correct, one is assured of certain facts regarding muscular contraction. Normally, material other than protein is utilized as a primary source of energy. This utilization involves the consumption of oxygen, the production of carbon dioxide, water and lactic acid. Whether this lactic acid is partially rebuilt into the energy-yielding substance, is further oxidized to carbon dioxide, or is eliminated as lactic acid is not yet clear. Possibly all three processes occur, the proportions obtaining depending upon the existing conditions. For example, the relative proportions of the acid metabolized in these different ways will depend among other things upon the rate at which the acid is formed and removed, the reaction and temperature of the seat of metabolism, and the supply of oxygen.

De Stoecklin found that the guaiacum blue reaction depends not on an enzyme but on the presence of hemoglobin. Oxyhemoglobin acts not only as a peroxydase but as an oxidase as well. It is important for the organism that the oxidizing enzymes commonly present in the tissues do not occur in the blood in the active state, since oxygen and foodstuffs coexist therein. The energy liberated by oxidation within the blood would be of little value in supplying the energy requirements of the actively working tissues.

Efficient muscular activity is intimately dependent upon an adequate supply of material for combustion, of oxygen to effect this combustion, and upon the removal of the products of cellular activity. This is achieved by the blood through the intermediation of the lymph. The material to be used as the source of energy comes in the first instance from the alimentary canal. It is stored in the muscles and other tissues during periods of rest. If it is true, as evidence by Weber would indicate, that constriction of the splanchnic vessels occurs in exercise, it is not probable that increased absorption of foodstuffs normally accompanies increased muscular activity. The marked increase in oxidative processes, however, requires a large increase in oxygen per unit amount of active tissue in unit time. This is effected by cooperation of the cardio-vascular system in increasing the blood flow, of the respiratory system in supplying more oxygen to the blood, and of the whole organism in increasing the number of red cells per unit quantity of blood. So too, is the accelerated removal of the products of activity achieved by the same agencies with the additional assistance of the excretory systems. Involved in the coordination of all of these changes to the one end of maintaining maximum efficiency in spite of increased energy demands, are the nervous and chemical coordinating systems.

Cardio-vascular system.—Bainbridge has brought out the following points in regard to the alterations which the cardio-vascular system undergoes in order to achieve its purpose of increased blood flow through the active tissues. The output of the heart per minute is increased during exercise both by a greater output per beat and an accelerated rate. The larger output per minute is dependent upon an increased venous inflow which in turn is partly the result of the increased mechanical pressure of the working muscles and of the movements of the respiratory muscles. Since the output of the heart per beat depends upon the length of the fibers at the beginning of systole (Starling's Law of the Heart), the increased diastolic filling of the heart consequent upon the increased venous inflow is therefore favorable to increased output per beat.

In an examination of the physiological results of bicycling, Bowen noted that at the onset of muscular work there was an immediate and rapid rise in pulse rate which he attributed to the nervous regulation of the heart rate; this was followed by a period during which the rate was uniform; then succeeded by a gradual rise which he thought was due to the accumulation of "waste products." The blood pressure was found to rise sharply, then gradually descend during the exercise. Higley and Bowen found that in work the rate of carbon dioxide production increases to a constant value.

In like manner the utility of an increased pulse rate in increasing the output per minute depends upon the rate of diastolic filling of the heart. If diastolic filling is slow, increased heart rate will not necessarily increase the output per minute; but if venous inflow is rapid, the increase will result in increased output per unit time.

Increased pulse rate is initially due to the diminution of vagus tone (Krogh and Lindhard), and the increase of accelerator tone (Bainbridge, 1914) by impulses from the higher nerve centers. Maintenance of an accelerated pulse is due in addition to the previous cause, to an increased body temperature (L. Hill, 1909) and a reflex lowering of vagus tone by the diastolic distention of the heart (Bainbridge, 1915).

Another suggested factor in the maintenance of an accelerated pulse is the possibility of an increased passage of adrenalin into the blood. Whether this increased activity of the suprarenals normally comes into play, is questioned however by Gasser and Meek.

Ordinarily the efficiency of the heart is about the same during exercise and rest. Failure of the heart to maintain its normal efficiency is found in instances of heart strain by overexertion. The oxygen consumption of the heart in exercise is much increased and oxygen must be made available if the heart is to function efficiently.

Besides the greater outflow per unit time from the heart, the increased blood flow through the active tissues is made further possible by the dilation of the arterioles of the muscles. If the splanchnic arterioles are constricted, though some evidence would question such an occurrence (Yates, unpublished results) an additional contributing factor to an increased blood flow through the active tissues would be operative. Bainbridge calculates this increased blood flow through the muscles from these factors as six to eight times the normal flow. The dilation of the arterioles in the muscles results from impulses from the vaso-motor center and from the local action of metabolites formed during contraction (Barcroft, Sohlberg). The constriction of the splanchnic vessels, if occurring, is probably almost entirely a vaso-motor reaction. There is then an altered blood pressure in exercise which is the resultant of several factors, among which may be mentioned, increased output per unit time and decreased resistance in the muscles. The part played by changes in blood volume and blood distribution, we shall consider later.

Respiratory system.—Upon the organs of respiration falls the duty of renewing the venous blood's depleted supply of oxygen, and removing its increased supply of carbon dioxide. This is accomplished by increased depth and rate of respiration. Evidence at the present time indicates that this increased pulmonary ventilation is the result of excitation of the respiratory center by an increased hydrogen ion concentration of the blood, by decreased blood flow and by afferent impulses. There may be, as Bainbridge has suggested, an increased sensitivity of the respiratory center due to the passage of impulses from the higher centers, or there may be a summation of stimuli, which though normally inadequate to provoke a response, are repeated at such frequent intervals that they are summed and become effective.

Excretory system.—Although Cushny does not specifically consider changes in the secretion of urine during muscular activity, certain facts may be deduced from known considerations. It is well known that intense muscular effort often leads to albuminuria even in the case of well-trained normal individuals. This may be correlated with the increase of serum proteins noted in severe exercise (Eckert). Albuminuria occurring in cases of heart disease, where the blood supply to the kidney has been diminished, may be an analogous phenomenon. Here there is a condition of partial asphyxia resulting in an alteration of the glomerular capsule, permitting the passage of protein. The excretion of water and nitrogen is markedly diminished, and in some cases of dogs which have come under my observation the secretion of urine has apparently been entirely abolished for a time. There is on the other hand a marked increase in the activity of the sweat glands of man and of the salivary glands of dogs.

CHANGES IN CHEMICAL ACTIVITY OF THE ORGANISM.

As to the chemical transformations in the organism resulting from exercise, accurate information is rather scant aside from that on the consumption of oxygen and the elimination of carbon dioxide. Not until Fletcher and Hopkins presented their carefully controlled results, did the increased concentration of lactic acid in fatigued over that in resting muscle become an accepted fact. Ryffel later detected it in greater concentration in the blood and urine of men after than before running. Other substances which have been found to bring about results in excised muscle resembling those resulting from fatigue produced by repeated contraction, are potassium dihydrogen phosphate, β-oxybutyric acid, indol, skatol, etc. (Lee). The concentration of these substances could conceivably be so altered in exercise that they would share in diminishing the efficiency of the organism, but proof that it is ordinarily so altered is yet lacking. Recent work indicates that the excretion of oxidized sulphur increases with muscular effort, and some evidence points to the significance of phenol excretion in this connection (Scott and Hastings). As a matter of fact, experimental work up to the present time points to the fact that any chemical substance of the organism involved in either the release of energy or in the maintenance of the machine for releasing it, undergoes some alteration in its form, concentration or distribution as the result of increased activity. It would seem therefore advisable to attack the problem of fatigue not so much from the standpoint of a search for a new substance resulting from work or for changes in amounts or concentration of isolated substances, as from the point of view that the organism is a physico-chemical system and that changes in the physico-chemical conditions must result from altered activity.

The experimental work to be described in this paper has been largely undertaken with the view of considering the problem of fatigue from the standpoint of the physico-chemical relationships involved. Since the most notable advances in reaching an understanding of the activity of the organism have been lately made by Barcroft, Parsons, Henderson, and their co-workers on the subject of the respiratory gases in their relation to the hydrogen ion concentration and ionic equilibrium of the blood, my later experiments were planned with the purpose of considering the effects of muscular activity from the viewpoint developed by these investigators. Some of the earlier experiments perhaps bear less directly upon the question as finally formulated, but were necessarily performed in the logical development of the problem. The work will be presented in the manner in which it was developed.

EXPERIMENTAL PROCEDURE.

CHOICE OF BIOLOGICAL MATERIAL.

The present knowledge of the chemical changes occurring in the organism in fatigue has been obtained from three types of biological material: the seat of activity, the muscles; the excretions, the respiratory gases, sweat, urine and feces; and the medium of transportation, the blood. Although theoretically the muscles are the ideal material to be used in a study of muscular activity, practically, they are unsuited for an investigation involving small changes in constitution or distribution of material in the living organism. The greatest care must be exercised in their use in order to prevent post-mortem changes, as those who have made lactic acid determinations upon them can so well testify. Further, the difficulty involved in sampling requires that a large number of determinations be made in order to arrive at an average value which is at all significant. And finally, in any investigation in which it is desired to follow progressively the course of the changes in exercise, their use is obviously out of the question.

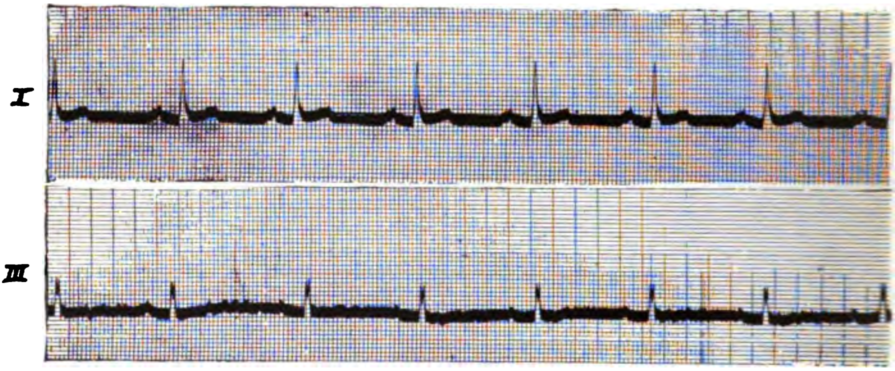
Much information of importance has been gained from chemical investigations of the excretions, in particular those of the pulmonary gases and the urine. Although by far the largest amount of energy transformed can be accounted for by a quantitative study of the respiratory exchange of gases, a study of the non-gaseous excretions is necessary for complete verification of the law of the conservation of energy as applied to the animal organism. The character of the non-gaseous excretions depends to such an extent upon the nutritional history of the organism, and still more upon the little understood nature of transportation of materials through living membranes, that consistent quantitative results are difficult to obtain, and to interpret. The ease of collection of this class of materials has contributed to making their use in investigations very extensive.

Because of the rapidity and accuracy with which it mirrors local and general chemical changes in the organism, the blood may be considered the least undesirable of possible biological materials to be used in an investigation of progressive changes such as occur during the course of muscular activity in the organism. The blood has been much used before, but the majority of experiments reported involved the use of such complicating procedures as anesthesia with cannulization, or, in some instances, venesection with or without an anesthetic. When it is desired to obtain information upon events occurring in the normal organism, it is impossible to impose complicating factors without vitiating the results. The experiments reported are not entirely free from criticism on this ground, but it is felt that the technic employed has more nearly permitted normal conditions than that employed in some of the experiments performed in the past.

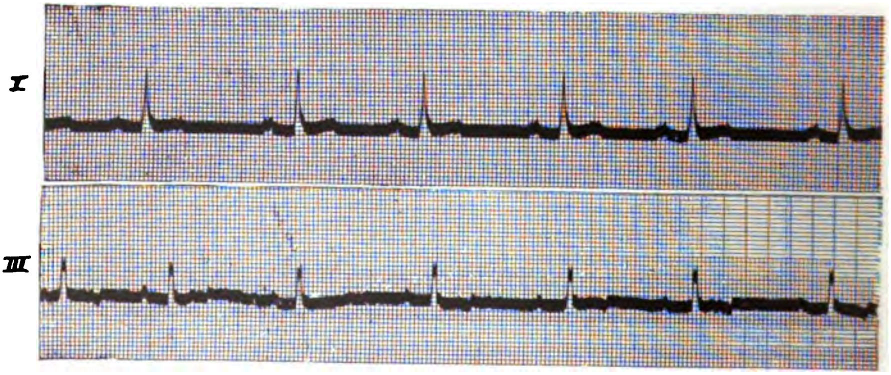
CHOICE OF EXPERIMENTAL ANIMALS.

Having concluded that the blood was best adapted to the needs of this investigation, it was necessary to decide upon the animal most suitable for experiments. Rabbits which had been previously employed by me in a related investigation were found to be unsuitable. Dogs on the other hand are in every way adapted to such an investigation as this; first because of their large size, thus permitting the withdrawal of relatively large samples of blood without introducing complications due to hemorrhage; second because they may be regarded as omnivors thereby making the results obtained from them more nearly applicable to man; third because they are more adaptable to laboratory conditions; and finally because of the ease with which they can be bled.

The impracticability of performing venepuncture on cats, obviated their use in experiments of the present nature. Dogs have therefore been used exclusively throughout this investigation and because of the fact that blood sampling has been the only procedure to which they have been subjected, in addition to the exercise imposed, it has been possible to keep the same individuals with one exception throughout the research. This had the obvious advantage of permitting one to study the several phases of fatigue on the same individual over a considerable period of seasonal changes. Most of the data were obtained from venous blood which was drawn into a centrifuge tube by aspiration from the jugular vein. When



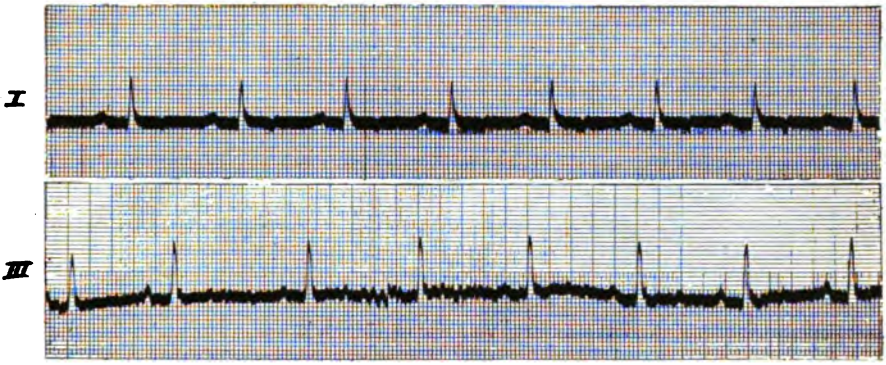
Before exercise and before cardiac puncture.



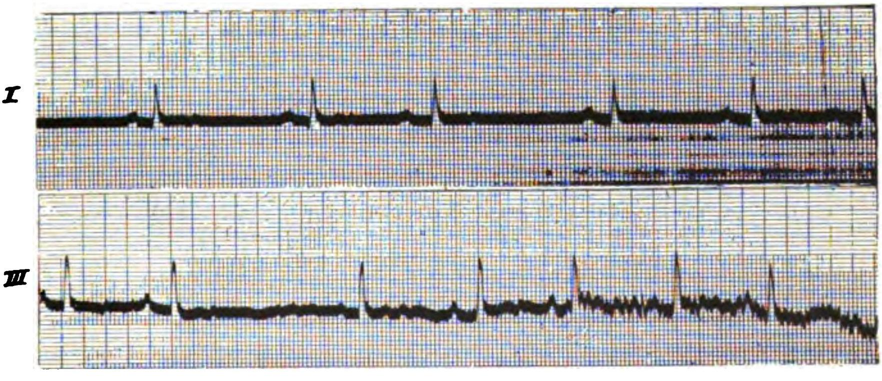
Before exercise and after cardiac puncture.

Fig. 1.—Part A: First and third lead electrocardiograms of dog H, before and after exercise, before and after cardiac puncture.

Abscissa, one division=0.02 sec.
Ordinate, one division=10^{-4} volts.



After exercise and before the second cardiac puncture.



After exercise and after the second cardiac puncture.

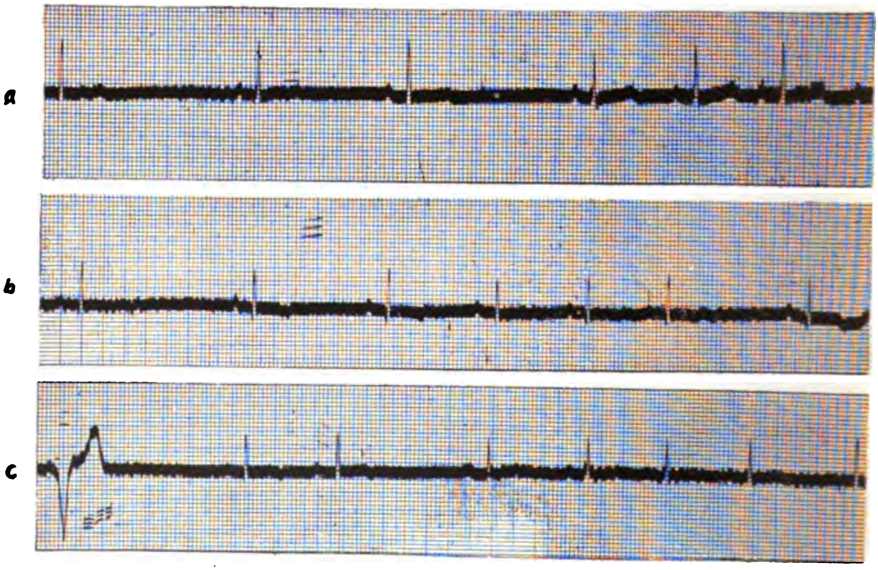


Fig. 1.—Part B: First lead electrocardiograms of dog E.

a, before exercise and before cardiac puncture.
b, before exercise and after cardiac puncture.
c, after exercise and before cardiac puncture.

(A second cardiac puncture was not made in this case.)

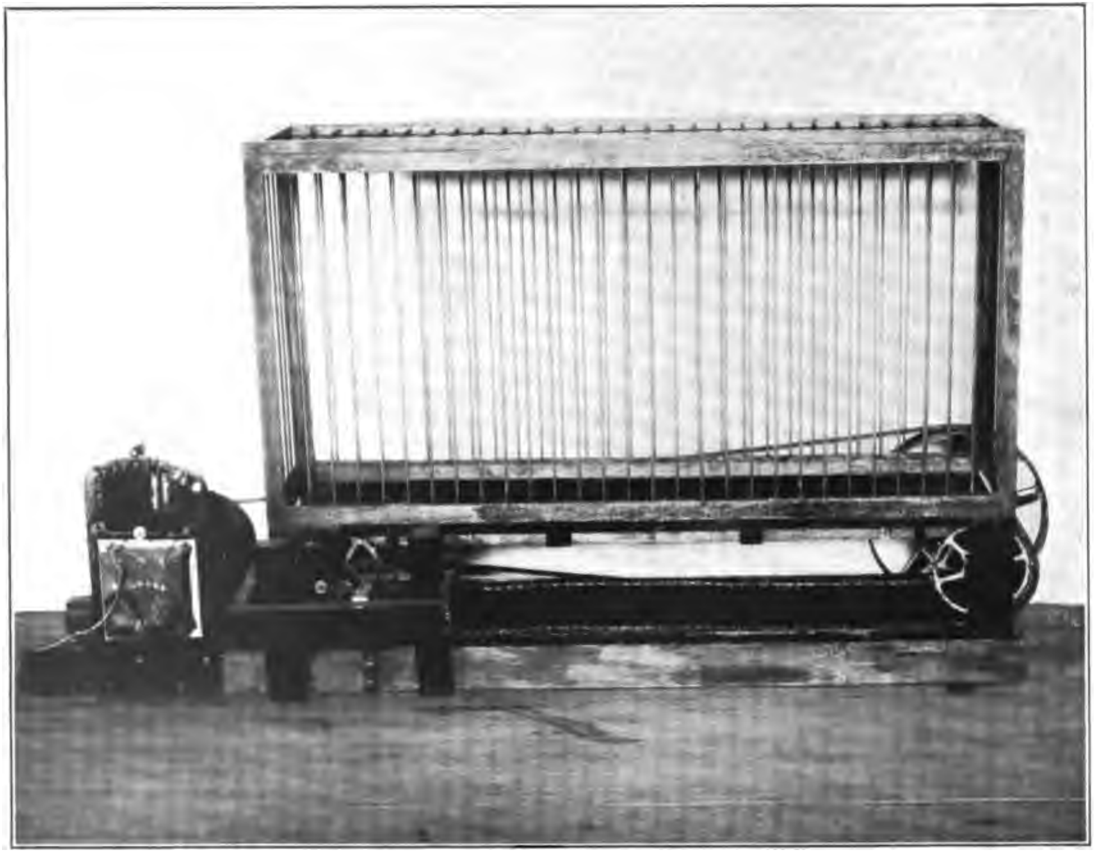


Fig. 2.

necessary to protect from the air, the blood was drawn under a layer of paraffin oil. Aside from the fact that it was found convenient to attach the needle directly to the tube passing to the bottom of the vessel, the technic was the same as that described by Van Slyke and Cullen.

METHOD OF OBTAINING BLOOD.

At a certain stage in the work it became desirable to compare arterial with venous blood. Although I had been informed that arterial blood could be obtained with comparative ease from the left ventricle, it was with considerable misgiving that the first attempt was made. It proved however to be such an easy and apparently painless procedure that I believe the technic to be worthy of description. A needle was attached directly to a pipette of about 20 c. c. capacity by means of rubber tubing. For convenience the stem below the cylindrical portion of the pipette was shortened to 5 cm. The dog was laid on his back and the apex of the heart located. The needle was inserted between the second and third ribs above the apex, slightly to the left of the median line. The blood usually rose in the pipette by its own pressure, although aspiration was sometimes applied by means of a rubber tube attached to the open end of the pipette. The four dogs used in these experiments where arterial blood was drawn are apparently normal at this time, six months after the ventricular punctures. Each participated in four experiments in the course of a month, making a total of eight punctures for each animal. It should be mentioned that between punctures in any one experiment the dog exercised strenuously for about four hours.

Anticipating that the question might properly be raised as to whether the normal functioning of the dog's heart had been impaired by this procedure, it was possible through the kindness of Dr. H. B. Williams and Mr. F. W. Keyes to obtain electrocardiograms of two of the dogs before and after puncturing the heart, before and after exercise. Because of the possible significance of these results it is believed worth while to publish typical portions of the records. (Fig. 1.)

The records of dog H show no marked deviation from normal after the ventricular puncture, either before or after exercise. The records of dog E show no change after the puncture made before exercise, but an extrasystole is apparent in the record obtained after exercise but before the second cardiac puncture. It seems probable that this abnormality resulted from the puncture but became evident only after the exercise. Therefore, while the puncture is not without possible injury to the heart musculature, the dogs seem not to have been seriously affected by it.

METHOD OF EXERCISING ANIMALS.

The usual laboratory means of exercising the animals has been by a revolving wheel, sometimes driven by a motor, sometimes turned by hand. This method was found unsuited for large dogs, and therefore in all experiments involving exercise to be reported in this paper, a motor-driven, horizontal treadmill was used which is pictured in Fig. 2. It was made by Mr. J. T. Hoyt, of this laboratory, and has been in almost constant use for two years. A counter records the distance travelled; a rheostat permits adjustment to any speed up to 12 miles per hour. The longest period of continuous operation has been nine hours representing a total distance of 65 miles. That the exercise is not entirely unwelcome to the dogs is indicated by the fact that one which has been in use since January, 1919, shows signs of evident displeasure when she is not permitted to run.

QUANTITATIVE ANALYSES.

The quantitative determinations made in this research have been carbon dioxide, oxygen, chloride, and hemoglobin. For blood gas determinations the Van Slyke apparatus has been used, for gas analysis the Henderson apparatus, and for the chloride estimation the Van Slyke and Austin method. To determine the hemoglobin content of blood the oxygen capacity was measured according to Van Slyke's method. In determining hemoglobin in solution, a colorimeter was usually employed, although in some cases where this was impossible an improvised spectrophotometer was used. Where knowledge of the distribution of substances between cells and plasma has been desired, a hemotocrit was used to determine the relative volume of the formed elements. At best hemotocrit determinations of the relative volume of the corpuscles are only approximations, but by standardizing the conditions under which they were made it was felt that the results would at least be comparable among themselves.

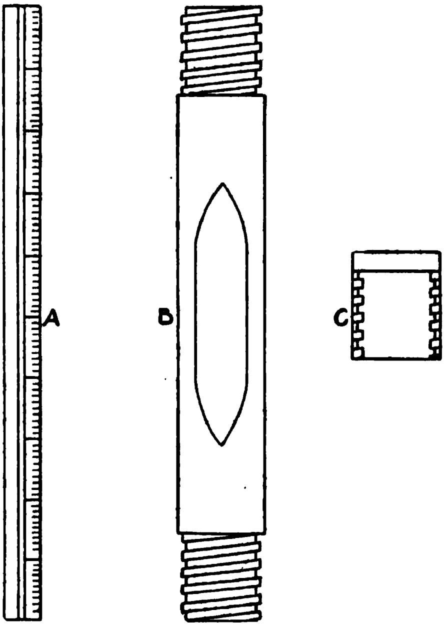


Fig. 3.—A precision hematocrit for the estimation of the relative volume of the formed elements of the blood.

The hematocrit designed by Dr. E. L. Scott is shown in detail in Fig. 3. A is a 10 cm. length of thermometer tubing, with a 0.5 mm.

bore, calibrated to 0.5 mm. After filling with blood, it was placed within the brass container B and the ends covered with leather caps. The brass ends C were then screwed in place. The hematocrits were then rotated at about 2,500 revolutions per minute in the centrifuge for 45 minutes, the minimum time required to obtain approximately constant readings. Table 1 contains the data of typical experiments to determine the length of time required to reach constant readings with the apparatus.

TABLE I.—*The effect of time of centrifugation upon hematocrit readings.*

[Rate=2,500 rev. per min.]

Duration of centrifugation in minutes.	Relative percentage of corpuscles.			
	Dog A.		Dog I.	
	Sample *a*.	Sample *b*.	Sample *a*.	Sample *b*.
15.......	0.570	0.570	0.511	0.512
30.......	0.560	0.560	0.506	0.505
45.......	0.556	0.555	0.503	0.501
60.......	0.555	0.555	0.501	0.500

The technic as finally employed for determining the percentage of erythrocytes laked by sodium chloride solutions of varying degrees of hypotonicity was as follows. One-cubic centimeter samples of fresh unclotted blood were added to 99 c. c. of salt solutions ranging in concentration from M/10 to M/20. After shaking, these solutions were allowed to stand for one hour. They were then centrifuged for 10 minutes. The supernatant liquid was removed and the hemoglobin contained therein was converted to CO-hemoglobin by passing illuminating gas through it. This was then compared in the colorimeter with a standard solution of CO-hemoglobin prepared according to the method described by Palmer. Knowing from the oxygen capacity of the blood its hemoglobin content, the amount of hemoglobin in the salt solution and the percentage laking produced could be calculated. When only the percentage laking produced by the salt solution was desired, a certain volume of the blood-salt mixture was diluted with an equal volume of 0.4 per cent ammonia and this solution after conversion of the hemoglobin to CO-hemoglobin, was used as the standard for the corresponding centrifuged solution. Other differences in technic adapting the procedure to the individual needs of the experiments will be described as they are encountered.

DESCRIPTION OF IMPROVISED SPECTROPHOTOMETER.

In certain instances it was impossible to make hemoglobin determinations by means of the colorimeter due to interfering colors or to the extreme dilution of the hemoglobin. It was necessary in these cases to employ the improvised spectrophotometer. This consisted simply of the substitution of a 10 cm. hand spectroscope for the telescope of the Duboscq colorimeter. The spectrum then appeared to be divided into two contiguous ones, with corresponding portions adjacent to each other. Now, when solutions giving absorption bands such as hemoglobin were placed in the cups of the colorimeter dark bands appeared across the spectra at their characteristic points. If solutions of equal concentration were used, then equality of the width of the lines would be obtained only in case the depths of the liquids through which the light passed were the same. In case the solutions were of different concentrations, equality of the lines would result only after the thickness of the liquid layers had been adjusted as in colorimetric measurements. No gain in accuracy was derived by this apparatus when the hemoglobin in the solution was greater than 10 per cent. But in solutions weaker than this, and in serum or plasma where other colors interfere with direct hemoglobin determinations, it was found of distinct advantage.

As often as possible the blood was examined immediately after withdrawal from the dog without the use of anticoagulants. Where it was impossible to do this, the anticoagulant used depended upon the subsequent treatment of the blood. If gas determinations only on whole blood were to be made, solid potassium oxalate was used. In blood volume studies, the anticoagulant was an isotonic solution of oxalate. When determining the distribution of substances, it was found that one drop of a molar solution of zinc sulphate in 25 c. c. of blood prevented coagulation without any determinable alteration of the properties of the blood under consideration. The use of a zinc salt as an anticoagulant was suggested by Dr. I. Greenwald who had successfully used it in connection with analyses of the inorganic salts of the blood. The minimum concentration in which zinc salts are effective as anticoagulants was determined by Buglia to be 0.0025 gram equivalents per liter of blood.

EXPERIMENTAL RESULTS.

OBSERVATIONS ON HEMOGLOBINEMIA.

In connection with previous experiments on the fatigue of dogs, the presence of a considerable amount of hemoglobin in the serum after exercise was repeatedly noted. The possibility that this hemoglobin might have resulted from the experimental procedure of drawing the blood or treating it after withdrawal was eliminated before any significance was attached to its appearance. It was found that when the blood was drawn under oil, into a clean centrifuge tube without exposure to the air, without the use of an anticoagulant, and was then immediately centrifuged, serum obtained before exercise showed no trace of hemoglobin when examined spectroscopically. When the same procedure was employed after exercise the resulting serum might or might not contain hemoglobin. This irregularity in results led to the belief for some time that the phenomenon must in some way be due to the handling of the blood. After repeatedly verifying the fact that the treatment of the blood was in no way responsible for the appearance of the hemoglobin, a quantitative study of its presence was attempted.

Table II.—*The appearance of hemoglobin in serum after severe exercise and its disappearance with training.*

	Date.	Distance.	Rate.	Hb in serum expressed as per cent. of Hb in whole blood.
		Miles.		
Dog A (had last exercised on Feb. 12)	June 21	20.2	6.6	1.12
	July 9	21.9	6.9	1.16
	July 12	2.5	....	....
	July 13	4.4	....	....
	July 14	7.6	....	....
	July 15	5.6	....	....
	July 16	24.0	6.2	0.0
	July 23	21.9	6.4	0.0
Dog E (had last exercised on Feb. 10)	June 28	22.3	6.4	0.45
	July 8	19.2	6.1	0.67
	July 14	14.9	5.3	0.01
	July 21	19.2	6.2	0.0
	July 28	17.9	5.6	0.0

Table III.—*Relation of serum Hb in fatigue to Hb content of blood.*

	Distance.	Rate in miles/hr.	Hb in blood as O_2 capacity/100 c. c.	Hb in serum as O_2 capacity/100 c. c.
	Miles.			
Dog A	20.2	6.6	33.4	3.7
	24.0	6.2	26.8	0.0
Dog E	22.3	6.4	24.8	1.1
	19.2	6.1	22.0	0.0
Dog H	21.0	7.0	33.2	1.2
	22.2	6.8	25.0	0.2

Effect of training.—By means of the improvised spectrophotometer previously described it was possible to estimate directly the quantity of hemoglobin appearing in the serum by comparing it with a solution containing a known amount of hemoglobin. In Table II are the results obtained from two series of observations made in this manner. Dog A, one in which the hemolysis in vivo has been often noted during the two years which she has been in this laboratory, had last been exercised in the treadmill, previous to the experiments in question, on February 12, 1920. It will be noted that after a run of 20 miles, the concentration of hemoglobin in the serum was about equal to that in a 1 per cent solution of her blood. Eighteen days later the dog was run 21.9 miles. Again hemoglobin was found in the serum in a concentration of about 1 per cent. Having observed that the hemoglobin was not evident when the dogs had been running at frequent intervals, this point was tested quantitatively. On four successive days dog A ran for an hour each day. On the fifth day she ran 24 miles. No hemolysis was produced. This observation has been confirmed upon the other dogs, the results on one of which are also given in Table II. The most striking point of divergence between the two cases was the marked difference in the magnitude of the hemolysis produced. At the present time we have no explanation for this. It may be of significance however that those dogs with a low percentage of corpuscles, with low oxygen capacity or hemoglobin content have not shown hemolysis in vivo to such an extent as those with a higher percentage of red cells. That this may be a correlated, but not necessarily a causal phenomenon is shown in Table III. Here it is seen that when hemolysis was observed, the hemoglobin of the blood was higher than when hemolysis had been eliminated by frequent and repeated periods of exercise. That the amount of hemolysis may depend absolutely as well as relatively upon the hemoglobin content of the blood is not excluded by the fact that dog H had a hemoglobin content as high as dog A but less than half the hemolysis. Dog H had been run rather frequently previous to this observation on hemolysis, while dog A, as Table II indicates, had not been run for over two months previous to this particular observation.

The conclusions from these experiments were: That hemolysis could be produced in vivo by fatigue in an untrained dog, that it could be eliminated by training, and that it was associated with the hemoglobin content of the blood. Reference to the occurrence of hemoglobin in the serum and urine after fatigue was made by Manca in 1895. Feigl and his coworkers in 1916 reported hemoglobinemia, hematinemia, and hemoglobinuria in the case of soldiers after a long march with full accoutrements, but proof of the cause of these phenomena is still lacking. Hawk found that in exercise the red cells always increased in number but that the increase was inversely proportional to the length of the period of exercise. He explained this by assuming that the initial effect of exercise was to cause the passage of previously inactive red cells into the blood; continued exercise however results in the destruction of the corpuscles, leading to their decrease.

The observations herewith reported were made without knowledge of the work of these previous observers, and I was led to inquire first, into the origin of the hemoglobin found in the serum and second into the disturbance in physico chemical processes which had led to its appearance. It might conceivably have had its origin either in the hemoglobin of the muscles or in that of the red blood corpuscles. Its presence in the serum might have resulted either from increased liberation from the source, or from decreased ability of the mechanism normally removing it from the organism to function efficiently.

On the assumption that the source of the hemoglobin was the red cells, and that one was dealing with a case of hemolysis in vivo, the study of the resistance of the erythrocytes to laking by hypotonic solutions was undertaken. Before passing to the description of these experiments the fact should be pointed out that the presence and amount of hemoglobin in the serum seems to be related to the hemoglobin content of the blood. This may be interpreted as evidence that its source is the blood and its presence is due to disturbances occurring within the blood.

In a classic paper upon the intimate nature of hemolysis, G. N. Stewart concluded that the alteration of the envelope is a necessary precursor to the freeing of the pigment. After the entrance of the water or laking agent into the corpuscle the hemochrome, or pigment as it exists in vivo, is transformed into an aqueous solution of hemoglobin, which, being foreign to the cell, passes into the extracorpuscular fluid.

CHANGES IN RESISTANCE OF ERYTHROCYTES TO LAKING.

In the first experiments upon the effect of exercise on the resistance of the erythrocytes to laking, sodium chloride solutions varying in concentration from M/10 to M/20 were chosen as the laking agents. The blood was drawn without exclusion of air and defibrinated; 1 c. c. samples were then placed in 99 c. c. of M/10, 11, 12, 13, 14, 15, 17, 20 sodium chloride solutions. Four minutes were allowed for the preparation of each solution. After standing 10 minutes longer the blood and salt mixtures were centrifuged. The amount of hemoglobin in the supernatant liquid was then determined by the method outlined above. The same procedure was followed after the dog had been fatigued. By plotting the percentage of the erythrocytes laked against the concentrations of the hypotonic salt solutions, curves such as those given in Fig. 4 were obtained. These were characterized by two unexpected points. First, the curve obtained after exercise fell below that obtained before exercise, i. e., the resistance of the erythrocytes had apparently increased. Second, the laking produced in M/12 sodium chloride was greater than that produced in M/13 solutions. This was not an isolated observation, but was observed in four successive experiments, so that

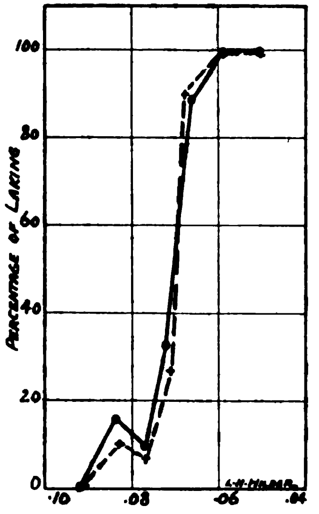


Fig. 4.—Resistance of red cells to laking by hypotonic salt solutions before and after exercise.

Solid line—before exercise.
Broken line—after exercise.

it did not appear to be due to accidental experimental errors. Attention was therefore first directed to an understanding of this phemomenon.

Effect of standing on blood salt solutions.—The first possible source of error that was thought of was the fact that the blood-salt mixtures did not all stand the same length of time before they were centrifuged. To determine the effect of this factor upon the degree of laking observed, experiments were performed in which portions of the blood-salt mixtures were centrifuged at stated intervals up to 4½ hours after withdrawal of the blood. The results of one such experiment are given in Fig. 5. It is seen that the degree of laking rose rapidly at first and then more slowly, so that after having stood one hour an error of plus or minus five minutes caused no change in the colorimetric determinations within the limits of experimental error. The length of time that the solutions stood after mixing may then have been a contributing factor to the apparently greater amount of laking by M/12 than by M/13 sodium chloride, because in any one experiment the M/12 mixture stood 34 minutes whereas the M/13 mixture stood 30 minutes. That this did not account for the major portion of the observed discrepancy, however, was shown by the fact that a difference of four minutes in the region of half an hour's standing produces an increase of only 1 per cent in the amount of laking. In Fig. 4 it is seen that a difference of from 5 to 8 per cent in the amount of laking existed between the two concentrations in question. It was necessary therefore to seek further for the cause of this phenomenon.

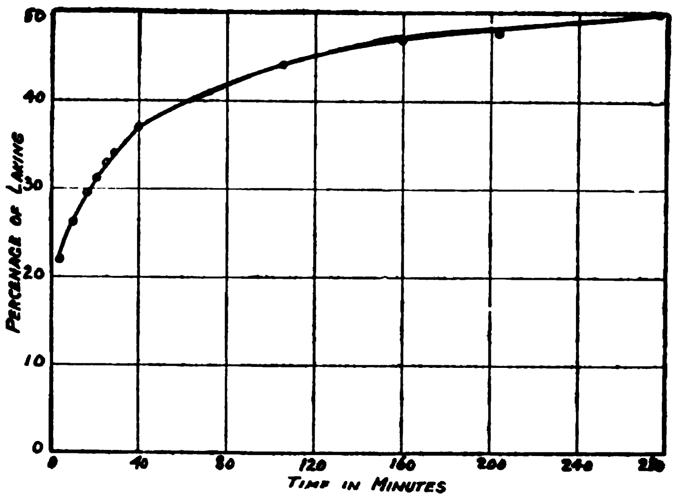


Fig. 5.—Effect of the length of time of standing of blood-salt mixture on percentage of laking produced by M/14 NaCl.

Effect of standing on blood.—The next thought was that the varying lengths of time which the blood stood in the laboratory before being added to the salt solutions might have been partially responsible for the irregularity. Experiments were planned to study the effect of this factor. The blood was drawn and defibrinated. Immediately, and at five minute intervals for 45 minutes, 1 c. c. samples were added to 99 c. c. of M/14 sodium chloride solutions. After each blood-salt mixture had stood for exactly 15 minutes, it was centrifuged and the percentage laking determined in the usual way. Plotting these results apparently showed that standing in the laboratory did increase the resistance of the erythrocytes to laking by hypotonic solutions. (Fig. 6, curve (*a*).) It was recognized however that no precautions had been observed to prevent access of the air, and another experiment was planned to eliminate this source of error. This time the blood was kept under oil in a covered receptacle. It was found that the resistance to laking decreased in approximately the same manner in which it had increased in the former experiment. (Fig. 6, curve (*b*).)

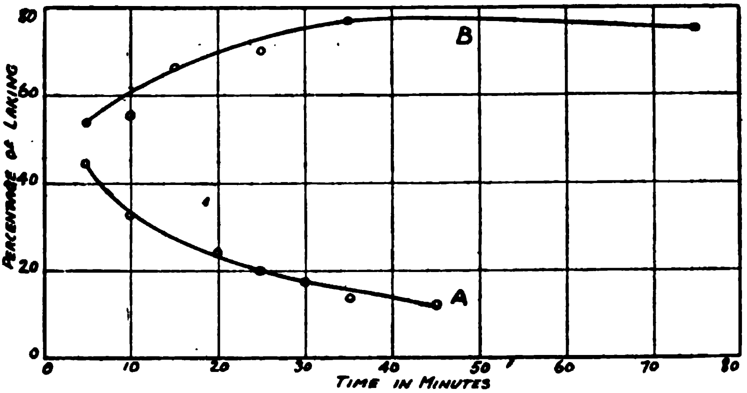


Fig. 6.—Effect of the time of standing of blood before being mixed with laking solution, on the percentage of laking produced by M/14 NaCl.

A—Blood allowed to stand exposed to the air.

B—Blood kept under oil.

All blood-salt mixtures stood 15 minutes before centrifugation.

Effect of gases on resistance.—In what way had the blood in the second experiment differed from that in the first? Manifestly, the change must have been due to its being protected by oil in the second case and to its not being so protected in the first case. The most obvious difference between the two samples was the arterial appearance of the first and the venous appearance of the second. Could the gases in the blood have been instrumental in the observed changes in resistance? Experiments therefore were devised which had for their purpose ascertaining the extent to which changes in the concentration of the blood gases influenced the resistance of the erythrocytes to laking by hypotonic solutions. In one such experiment, the blood after withdrawal, was defibrinated, then partially reduced with gaseous hydrogen. One-half of this blood was reoxygenated, the other portion was kept reduced. One per cent mixtures with M/14 sodium chloride were prepared and the curves of laking determined in the manner described above. Fig. 7 shows the result of this experiment. The resistance was markedly increased by reoxygenation. At 60 minutes, for example, 62 per cent of the reduced blood had been laked, but only 45 per cent of the reoxygenated sample. Analyses showed 24.3 volumes per cent of oxygen in the former and 30.1 volumes per cent in the latter sample of blood. Other experiments indicated that carbon dioxide had the reverse effect, namely, that an increase in carbon dioxide content resulted in a decrease of the resistance of the corpuscles.

Being satisfied as to the importance of the blood gases in determining the resistance of the erythrocytes, the subsequent experiments on the relation of this phenomenon to fatigue took into account these modifying factors. The blood was drawn under oil without the use of an anticoagulant. Five c. c. were immediately added to 495 c. c. of M/13 or M/14 sodium chloride solutions and the amount of laking resulting, determined at 15-minute intervals for 75 minutes. After subjecting the dog to a given amount of exercise, the laking curve was again determined. The curves obtained in one such experiment are shown in Fig. 8. Thus at 60 minutes, 51.3 per cent laking had been produced in the blood drawn before exercise, whereas only 33.4 per cent laking had been produced in the blood drawn after exercise. The exercise in this instance consisted of running 18.7 miles at 6.8 miles per hour. Thus it was found that muscular effort did increase the resistance of the erythrocytes, when the access of air to the blood after withdrawal of the blood was prevented. In each subsequent experiment on the resistance of

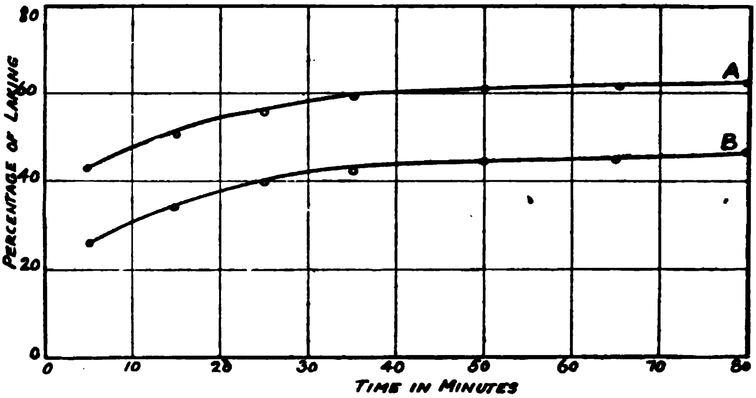


Fig. 7.—A comparison of the effect which (A) reduction with hydrogen and (B) reoxygenation of hemoglobin had on the percentage of laking produced by M/14 NaCl. Determinations of amount of laking were made at intervals up to 80 minutes.

the cells, at least six points were obtained from which the laking curve was plotted. Since it is impossible to publish each curve, the percentage laking produced at the end of 60 minutes has been chosen as the resistance value. This is the figure by which the resistance of the cells is characterized in the following discussion.

EFFECT OF EXERCISE ON BLOOD GASES AND RESISTANCE.

The next question was: Are the changes in the blood gases produced by exercise in harmony with these results? Consider first the oxygen content. (Table IV.) The average of 13 analyses of the oxygen content of the venous blood, before and during various stages of exercise, indicated that it was increased at the end of two hours but thereafter gradually declined in value. The hemoglobin content of the blood, as measured by its oxygen capacity, however, increased but at a diminishing rate. The percentage saturation of the hemoglobin was greater at the end of two hours, but was thereafter less than at the beginning of the exercise. The average of 12 analyses of the bicarbonate content of the plasma, measured on different individuals and at different times, but over comparable periods of work, showed a progressive diminution. If, then, as the experiments on the blood in vitro indicated, the increase of oxygen or the diminution of carbon dioxide caused an increase in the resistance of the corpuscles to laking, one might have anticipated from these pre-

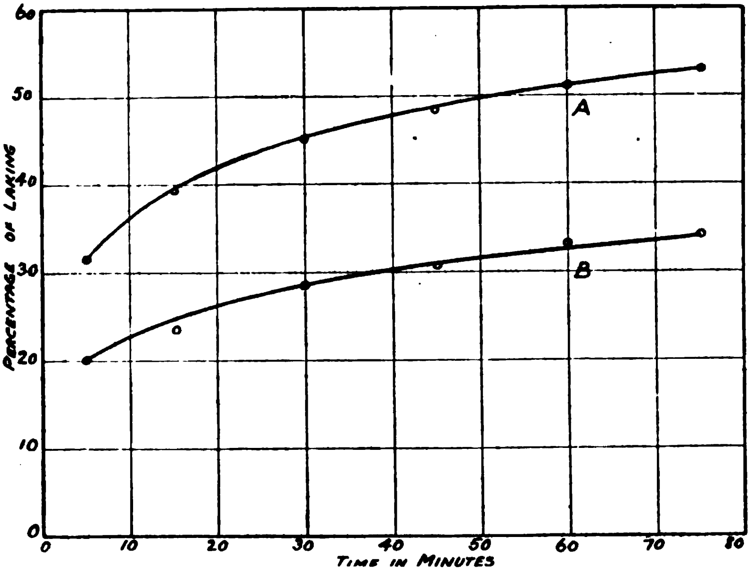


Fig. 8.—Laking curves obtained on the blood of dog H before exercise (curve A), and after exercise (curve B). Laking solution was M/13 NaCl.

Ordinates—percentage of cells laked.

Abscissae—time which blood-laking solution mixture stood before centrifugation.

viously acquired figures that changes in resistance attendant upon exercise, could be accounted for by the changes in the gases of the blood. In order to prove this point experimentally, one needed to determine the gases of the blood and the resistance of the corpuscles on the same samples under different gas tensions, produced within the organism first at rest, then after exercise. Experiments were therefore undertaken in which the following analyses were made: The oxygen content, the hemoglobin content, the carbon dioxide content, and the resistance to laking of the erythrocytes in both arterial and venous blood.

TABLE IV.—*The effect of exercise upon the gases of the venous blood of dogs.*

	Number of experiments.	Duration of exercise in hours running.			
		0	2	4	6
Oxygen content in volumes per cent	13	16.1	17.3	17.0	16.6
Oxygen capacity in volumes per cent	13	24.8	25.6	26.4	26.4
Per cent saturation of hemoglobin	13	65.0	67.5	64.3	62.9
Bicarbonate content of plasma	12	56.6	52.3	48.5	44.9

TABLE V.—*Summary table representing the average of eight experiments in which determinations of oxygen, hemoglobin, carbon dioxide and resistance to laking were made on the same samples of arterial and venous blood before and after exercise.*

[Average distance run=17.7 miles.]

	Before exercise.		After exercise.	
	Arterial.	Venous.	Arterial.	Venous.
Resistance	51.0	56.0	42.0	43.0
Carbon dioxide	38.3	40.5	31.6	32.7
Oxygen	19.3	14.3	20.6	15.0
Hemoglobin	21.3	20.5	22.4	23.4
O_2/Hb	90.6	69.7	92.0	64.1

The results of those experiments in which all analyses were complete are presented in Table V. The outstanding points are as follows: The resistance to laking was greater in venous than in arterial blood before exercise. There was associated with this difference, a greater carbon dioxide content, a less oxygen content, a slightly less hemoglobin content, and a smaller percentage saturation of the hemoglobin with oxygen, in the venous than in the arterial blood. Exercise resulted in the following changes: The resistance to laking was increased; the carbon dioxide content was decreased; the oxygen content and the hemoglobin content were slightly increased in both the arterial and venous blood. The percentage saturation of the hemoglobin with oxygen was increased slightly in the arterial and decreased in the venous blood. After exercise, the average difference in the resistance of the arterial and venous erythrocytes was too slight to be of significance. The possible reasons for this will be discussed when the individual determinations are considered. As the result of the average of the complete experiments one may say therefore that the changes in the gases of the blood were in harmony with the observed changes in the resistance of the erythrocytes to laking.

How far could these average results be applied to individuals and to single determinations upon individuals? The data showing to what extent this could be done are given in Tables VI, VII, VIII, IX, X. Consider dog A. The resistance to laking and the carbon dioxide content of the venous blood were slightly greater than that of the venous blood before exercise. The oxygen content and the percentage saturation of the hemoglobin with oxygen were respectively less. After exercise the resistance and the carbon dioxide content were less in both the arterial and venous samples than they had been before exercise. The oxygen content and the percentage oxygenation of the hemoglobin were greater in the arterial blood after than before exercise. In the venous blood, the oxygen content had slightly increased, but the percentage saturation of the hemoglobin had decreased. In view of the average higher resistance of the venous than the arterial blood after exercise in the case of dog A, I wish to call attention to the experiment of July 23 on this dog. The resistance of the arterial and venous bloods after exercise were respectively 43 and 37; the corresponding carbon dioxide contents were 33.4 and 27.8 volumes per cent. The records show that six minutes elapsed between the drawing of the venous and arterial samples after the dog was removed from the treadmill. This was sufficient time for the respiration to have adjusted itself more nearly to the conditions prevailing in rest. Since the carbon dioxide content of the arterial blood was found to be greater in rest than in work, the greater amount of carbon dioxide in the arterial than in the venous samples after exercise in this and other instances in which it was noted, becomes understandable. One finds that on July 14 and August 13, experiments on dog E led to the same results with apparently the same underlying reasons. It is perhaps unfortunate that practical difficulties prevented the drawing of the arterial and venous samples simultaneously, but the very occurrence of these anomalous results provides additional verification of my thesis.

TABLE VI.—*The resistance of the erythrocytes of the arterial and venous blood, before and after exercise, expressed as the percentage of laking produced by hypotonic salt solutions at the end of one hour.*

Dog.	Date.	Distance in miles.	Concentration of NaCl sol.	Before exercise.		After exercise.	
				Arterial.	Venous.	Arterial.	Venous.
A	July 9	21.9	M/14	90	84	78	80
	July 16	24.0	M/13	72	88	....	....
	July 23	21.9	M/13	64	59	43	37
	July 30	20.7	M/13	48	50	....	40
Average	....	22.5	....	68	70	56	52
	Aug. 5	00.0	M/13	65	73	58	70
E	July 8	19.2	M/14	70	76	64	67
	July 14	14.9	M/13	16	24	16	10
	July 28	17.9	M/13	34	42	28	22
	Aug. 13	15.0	M/13	20	22	17	15
Average	....	16.8	....	34	38	30	29
	Aug. 4	00.0	M/13	25	30	25	37
H	July 19	9.6	M/13	61	75	45	50
	July 26	22.2	M/13	56	66	47	54
	Aug. 12	19.9	M/13	51	58	....	30
Average	....	17.2	....	56	68	53	53
	Aug. 2	00.0	M/13	57	70	58	72

TABLE VII.—*The carbon dioxide content of the arterial and venous blood before and after exercise, expressed as volumes per cent.*

Dog.	Date.	Distance in miles.	Before exercise.		After exercise.	
			Arterial.	Venous.	Arterial.	Venous.
A	July 9	21.9	32.9	32.9	18.3	21.5
	July 16	24.0	32.8	33.8	27.6	29.0
	July 23	21.9	35.2	41.7	33.4	27.8
	July 30	20.7	41.8	41.0	33.6	35.4
Average	....	22.5	35.8	37.8	28.2	28.4
	Aug. 5	00.0	41.0	41.0	29.0	46.4
E	July 8	19.2	....	42.7	28.2	31.8
	July 14	14.9	42.3	45.1	38.3	38.1
	July 21	19.2	40.5	46.1	35.9	42.4
	July 28	17.9	41.4	46.1	38.5	40.9
	Aug. 13	15.0	47.3	47.3	38.2	32.7
Average	....	17.2	42.9	45.5	34.8	37.2
	Aug. 4	00.0	43.1	49.7	43.1	53.5
H	July 19	9.6	32.9	36.6	32.9	32.9
	July 26	22.2	35.6	31.3	31.3	36.0
	Aug. 12	19.9	36.4	39.1	28.2	32.7
Average	....	17.2	35.0	35.6	30.8	33.9
	Aug. 2	00.0	33.8	43.2	28.0	42.8
J	Aug. 3	17.2	41.3	41.3	38.4	41.3
	Aug. 6	17.2	44.8	50.3	44.1	46.8
Average	....	17.2	43.0	45.8	41.2	44.0

TABLE VIII.—*The oxygen content of arterial and venous blood before and after exercise, expressed in volumes per cent.*

Dog.	Date.	Distance in miles.	Before exercise.		After exercise.	
			Arterial.	Venous.	Arterial.	Venous.
A	July 9	21.9	21.3	19.0	24.2	17.8
	July 16	24.0	22.1	15.2	24.2	19.8
	July 23	21.9	22.9	19.9	26.5	21.4
	July 30	20.7	23.9	21.9	25.9	19.3
Average		22.1	22.5	19.0	25.2	19.6
	Aug. 5	00.0	21.3	15.1	20.7	19.6
E	July 8	19.2	15.2	12.3	17.6	12.7
	July 14	14.9	18.1	9.9	19.9	17.2
	July 21	19.2	17.6	12.3	20.2	17.8
	July 28	17.9	15.8	9.3	17.3	10.6
	Aug. 13	15.0	18.2	15.6	18.2	12.6
Average		17.2	17.0	11.9	18.6	14.2
	Aug. 4	00.0	19.2	14.7	16.5	8.0
H	July 19	9.6	20.1	13.5	19.6	14.8
	July 26	22.2	22.8	15.1	22.7	12.6
	Aug. 12	19.9	19.8	10.5	19.7	10.8
Average		17.2	20.9	13.0	20.7	12.7
	Aug. 2	00.0	22.8	12.5	21.8	9.1
J	Aug. 3	17.3	18.3	13.4	18.3	14.3
	Aug. 6	17.2	17.8	12.7	19.2	12.8
Average		17.2	18.0	13.0	18.7	13.5

TABLE IX.—*The hemoglobin content of the arterial and venous blood before and after exercise, expressed in volumes per cent of oxygen capacity.*

Dog.	Date.	Distance in miles.	Before exercise.		After exercise	
			Arterial.	Venous.	Arterial.	Venous.
A	July 9	21.9	23.9	23.2	26.0	27.5
	July 16	24.0	24.4	23.2	26.0	26.8
	July 23	21.9	23.9	23.4	26.5	27.5
	July 30	20.7	26.0	25.7	27.7	30.6
Average		22.5	24.5	23.9	26.5	28.1
	Aug. 5	00.0	24.4	24.4	22.8	22.8
E	July 8	19.2	17.6	17.2	19.8	20.0
	July 14	14.9	20.6	18.9	21.3	22.6
	July 21	19.2	18.5	18.2	21.3	22.0
	July 28	17.9	18.6	18.3	19.4	19.4
	Aug. 13	15.0	19.8	19.8	20.8	22.8
Average		17.2	19.0	18.5	20.5	21.3
	Aug. 4	00.0	20.7	20.7	20.4	19.7
H	July 19	9.6	21.4	21.0	20.5	23.5
	July 26	22.2	24.5	22.3	24.8	25.0
	Aug. 12	19.9	20.8	19.4	22.6	22.8
Average		17.2	22.2	20.9	22.6	23.4
	Aug. 2	00.0	23.6	22.7	21.8	21.8
J	Aug. 3	17.3	19.3	19.3	19.6	20.0
	Aug. 6	17.2	20.3	20.3	21.1	20.9
Average		17.2	19.8	19.8	20.4	20.4

TABLE X.—*The percentage saturation of the arterial and venous blood with oxygen before and after exercise, expressed in per cent.*

Dog.	Date.	Distance in miles.	Before exercise.		After exercise.	
			Arterial.	Venous.	Arterial.	Venous.
A..	....	21.9	89.2	81.9	93.0	64.7
	July 16	24.0	90.6	65.5	93.0	73.9
	July 23	21.9	95.7	83.2	100.0	77.8
	July 30	20.7	91.9	85.2	97.1	63.6
Average..............................	....	22.1	91.9	79.5	95.1	69.7
	Aug. 5	00.0	87.3	61.9	90.8	85.9
E..	July 8	19.2	86.4	71.5	88.8	63.5
	July 14	14.9	87.9	52.4	93.4	76.1
	July 21	19.2	95.1	67.6	94.8	80.9
	July 28	17.9	85.0	50.9	89.2	54.6
	Aug. 13	15.0	92.0	73.8	87.5	55.2
Average..............................	....	17.2	98.5	64.4	90.7	66.6
	Aug. 4	00.0	92.7	71.0	80.9	40.6
H..	July 19	9.6	94.0	64.3	95.6	63.9
	July 26	22.2	93.0	67.7	91.5	50.4
	Aug. 12	19.9	95.1	54.1	87.2	47.4
Average..............................	....	17.2	94.2	62.3	91.6	54.3
	Aug. 2	00.0	96.6	55.1	100.0	41.8
J..	Aug. 3	17.3	94.8	69.4	93.3	71.5
	Aug. 6	17.2	87.6	62.5	91.0	61.3
Average..............................	....	17.2	91.0	65.0	91.7	66.2

Having found that in some cases the carbon dioxide content was greater in the arterial than in the venous samples after exercise, it may properly be questioned whether or not in those instances in which it was less in the former than in the latter, the differences may not have been as great as would have actually existed, had it been possible to draw the arterial and venous blood simultaneously. This is felt to be the case, and it is for this reason therefore that one can not attach too much significance to differences noted between the arterial and venous samples after exercise.

What has been said of the conditions obtaining in the arterial and venous blood before exercise and the effect of exercise upon these conditions in the case of dog A was true as well for dogs E, H, and J. It may be concluded therefore that the conclusions drawn from the average of all the results apply equally well to individual results. Certain characteristics of the data peculiar to the individual subjects are perhaps worthy of passing attention.

For purposes of comparison one may say that in M/13 NaCl, erythrocytes of the arterial blood of A had an average resistance value of 62; of E, 24; of H, 56 (Table XI). Corresponding values for the carbon dioxide content of A, 36.8; of E, 42.9; of H, 34.7; of J, 43.0. For the oxygen content, the figures were, for A, 22.3; for E, 17.4; for H, 21.4; for J, 18.0. For the hemoglobin content, the values of 24.5 for A; for E, 19.3; for H, 22.5; for J, 19.8. The percentage oxygenation of the hemoglobin represented by the values of 91.0 for A; of 90.2 for E; of 95.1 for H; of 90.9 for J. A point to be noted here is that hemolysis in vivo has been found to be always more severe in the cases of dogs A and H than in dog E. In keeping with this one found a higher resistance to laking in the case of dog E than of A or H. I further found that the hemoglobin content of the arterial blood of E was characteristically lower than that of A or H.

TABLE XI.—*A comparison of the blood gases and the resistance of the red cells of the arterial blood of different dogs.*

Determination.	Dog A.	Dog E.	Dog H.	Dog J.
Resistance	62	24	56	20
CO_2 content	36.8	42.9	34.7	43.0
O_2 content	22.3	17.4	21.4	18.0
Hb content	24.5	19.3	22.5	19.8
O_2/Hb	91.0	90.2	95.1	90.9

TABLE XII.—*The change in concentration of chlorides in corpuscles and plasma as the result of exercise.*

[Results are expressed in grams of sodium chloride per liter.]

Dog.	Date.	Distance in miles.	Concentration of chlorides.			
			In plasma.		In corpuscles.	
			Before exercise.	After exercise.	Before exercise.	After exercise.
H	Sept. 17	13.4	6.60	6.85	3.91	3.71
K	Sept. 15	16.3	6.45	6.85	3.95	3.69
K	Oct. 23	12.5	6.55	6.65	4.24	4.11
J	Sept. 21	18.5	6.45	6.85	4.23	3.65
Average	....	....	6.51	6.80	4.08	3.79

TABLE XIII.—*Experiment on defibrinated blood. Sample I equilibrated with air containing 10 per cent CO_2. Sample II equilibrated with laboratory air.*

	In plasma.		In corpuscles.	
	Sample I.	Sample II.	Sample I.	Sample II.
Concentration of chlorides	6.60	7.15	4.20	3.29
Resistance of erythrocytes to laking in M/13 NaCl	....	....	60.6	19.3

Having observed that whenever changes were encountered in the gases of the blood at any time, one might anticipate changes in the resistance of the erythrocytes to laking by hypotonic solutions, the next phase of the investigation was an examination into the intimate nature of these changes in gases as affecting the resistance to laking.

EFFECT OF EXERCISE ON CHLORIDE DISTRIBUTION.

Knowing from the early work of Hamburger, and the later investigations of Henderson and Lundsgaard, that alterations in carbon dioxide tension cause redistribution of the bicarbonate and chloride ions between the corpuscles and plasma, experiments were devised to determine whether changes in the distribution of chlorides occurred in fatigue. Results of these experiments are given in Table XII. Four experiments on dogs H, J, and K indicated that the concentration of chlorides in the plasma increased from an average concentration of 6.51 to 6.80 and that the concentration of chlorides in the corpuscles decreased from 4.08 to 3.79. In all those cases an increase in the resistance of the corpuscles was noted. To make certain that this same result could be produced by alterations of the carbon dioxide tension of the blood, blood drawn from dog E was defibrinated and divided into two portions (Table XIII). One part was equilibrated with an atmosphere containing 10 per cent carbon dioxide, the other was brought into equilibrium with the air. The concentration of chlorides in the serum of the former blood were 6.60, of the latter 7.15. The chlorides in the corpuscles of the former were 4.20, of the latter 3.29. Moreover the resistance of the corpuscles to laking had been proportionately increased in the latter. This showed that changes in carbon dioxide tension associated with changes in the chloride concentration of the corpuscles resulted in changes in the resistance of the corpuscles to laking. Before passing to a discussion of these experiments and proposing a conception of the mechanism of the changes observed, there remains to be described a series of experiments devised to investigate the effect of the duration of muscular effort upon certain of the factors studied.

TABLE XIV.—*The progressive effect of exercise upon the chlorides of the plasma and of the corpuscles compared with the changes in the resistance of the corpuscles to laking.*

Dog.	Date.	Determination.	Duration of exercise in hours.			
			0	1	2	3
E	Sept. 30.	Resistance	58.2	43.2	20.9	21.4
		Plasma Cl	6.05	6.15	6.55	6.65
		Corpuscular Cl	4.43	4.16	2.98	3.68
E	Oct. 9.	Resistance	37.5	36.0	27.2	30.2
		Plasma Cl	6.40	6.45	6.55	6.65
		Corpuscular Cl	3.90	4.14	3.56	3.80
H	Oct. 2.	Resistance	87.7	85.5	80.6	....
		Plasma Cl.	6.65	6.75	6.75	....
		Corpuscular Cl	3.70	3.75	4.06	....
J	Sept. 29.	Resistance	62.5	46.8	28.0	22.6
		Plasma Cl	6.80	6.85	6.95	7.00
		Corpuscular Cl	3.77	4.25	3.96	3.34
J	Oct. 16.	Resistance	58.9	55.2	53.0	48.3
		Plasma Cl	6.40	6.30	6.55	6.75
		Corpuscular Cl	4.15	4.60	4.08	3.71
K	Sept. 27.	Resistance	93.5	49.1	44.7	56.2
		Plasma Cl	6.65	6.75	6.90	6.97
		Corpuscular Cl	4.10	3.38	2.82	3.74
Average		Resistance	66.4	52.6	42.4	43.1
		Plasma Cl	6.49	6.54	6.70	6.80
		Corpuscular Cl	4.01	4.04	3.58	3.64

EFFECT OF CONTINUED EXERCISE ON CHLORIDES AND RESISTANCE.

Six experiments upon four dogs were performed to determine in what way the resistance of the erythrocytes was related to the amount of muscular effort. Table XIV and Fig. 9 illustrate the results of these experiments. It will be seen that in dog J the resistance of the corpuscles to laking increased with increasing amounts of exercise. In the case of dogs K and E this did not occur. After a certain amount of exercise, varying somewhat from experiment to experiment, the resistance reached a maximum and began to decrease. It is evident from an examination of the data of dog J, that the resistance was increasing at a diminishing rate after two hours of running. It is therefore believed that the resistance of the erythrocytes would have shown a tendency to decrease had the experiments been carried sufficiently far. Comparisons were also made between the concentration of chlorides in the corpuscles and the resistance of the cells with varying amounts of exercise. It will be seen that an increase in resistance is usually but not invariably accompanied by a decrease in the corpuscular concentration of chlorides. No explanation is offered at this time as to why there were exceptions to the general rule.

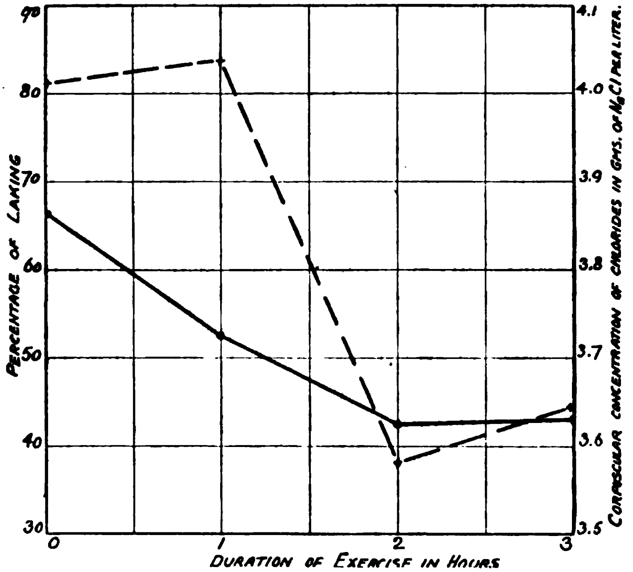


Fig. 9.—Curves illustrating the progressive change in the resistance of red cells to laking by hypotonic solutions (solid line) and comparable changes in corpuscular concentration of chlorides (broken line) with increasing amounts of muscular activity.

LACTIC ACID DETERMINATIONS.

Several months later lactic acid determinations by Ryffel's method were made on the blood of dogs E, H, and J. These results are tabulated in Table XV. It will be seen by Ryffel's statement that a short period of severe exercise leads to an increase in the concentration of the lactic acid of the blood is confirmed, dog H; but moderate exercise, continued for considerable time leads to a diminution in its concentration.

TABLE XV.—*The changes in the lactic acid concentration of the blood under varying amounts and intensity of muscular effort.*

Dog E	Distance run in miles	0.0	11.2	19.5	27.0
	Rate in miles per hour	0.0	4.5	4.4	4.5
	Lactic acid in mg. per 100 c. c	7.8	6.7	6.0	6.2
Dog E	Distance run in miles	0.0	2.5	5.7	11.0
	Rate in miles per hour	0.0	5.0	4.6	5.0
	Lactic acid in mg. per 100 c. c	4.9	3.1	2.9	2.9
Dog H	Distance run in miles	0.0	0.24	4.6	10.8
	Rate in miles per hour	0.0	8.2	7.7	5.0
	Lactic acid in mg. per 100 c. c	12.4	19.9	12.4	6.3
Dog J	Distance run in miles	0.0	6.15	10.5	16.1
	Rate in miles per hour	0.0	5.5	5.3	5.3
	Lactic acid in mg. per 100 c. c	4.5	....	4.5	2.6

DISCUSSION.

We will consider first the experimental results in their relation to the blood itself, then in relation to the animal as a whole.

The average effect of exercise on blood from the jugular vein may be summarized as follows: The resistance of the erythrocytes to laking by hypotonic salt solutions is increased, the concentration of chlorides in the corpuscles is diminished, the carbon dioxide content of the whole blood is diminished, the bicarbonate of the plasma is diminished, the percentage saturation of the hemoglobin with oxygen is increased, the hydrogen ion concentration of the plasma is not measureably altered (Hastings). With these facts in mind let us examine their possible meaning in the light of Lawrence J. Henderson's recent conceptions of the variable chemical behavior of hemoglobin.

RELATION OF RESULTS TO ACID-BASE EQUILIBRIA IN THE BLOOD.

An increased oxygen tension in the blood is associated with a diminished carbon dioxide tension. This is the usual condition obtaining in the jugular blood at the beginning of strenuous exercise. The percentage of the hemoglobin existing in the form of oxyhemoglobin has therefore been increased. It is known that $HHbO_2$ is a stronger acid than HHb. More base would therefore be associated with the former than with the latter. The source of this base would be the BA, probably largely the BCl, within the corpuscles. This would lead to the formation of HCl within the corpuscles, and a consequent rise in their hydrogen ion concentration, were there no means of coping with this change. In the plasma, the diminished carbon dioxide tension would lead to a potential excess of $BHCO_3$ and a resultant diminution in its hydrogen ion concentration. The corpuscles being freely permeable to H and Cl ions however, the HCl passes to the plasma where interaction between the $BHCO_3$ and HCl occurs, thus restoring the normal hydrogen ion concentration of both corpuscles and plasma.

But complete equilibrium can not be considered as having yet been reached. The intracorpuscular osmotic pressure is dependent, among other things upon the concentration of BCl within the corpuscles. If the changes just described occur, HCl will migrate into the plasma and the base left in the corpuscles will be associated with the hemoglobin. But if it may be assumed that the base-hemoglobin compound is less effective osmotically than the BCl formerly there, the intracorpuscular osmotic pressure will have been lowered. Water will therefore pass from the corpuscles to the plasma until osmotic equilibrium is again established. This will result in a diminished volume of the corpuscles. Now the corpuscles may be conceived as requiring a certain internal pressure to bring about such a modification in the permeability of their limiting surface that the hemoglobin can escape. I find it convenient to consider this change an increase in the size of the interstitial pores, although the particular view held regarding how the substances pass through the corpuscular surface is immaterial for our present purposes. The point of importance is that, given a lower osmotic pressure within the corpuscles, a lower osmotic pressure in the external medium will be required to bring about the same change in permeability. This would be experimentally represented as an increased resistance of the corpuscles to laking by hypotonic solutions. The experimental results seem to bear out this conception of the mechanism of the changes in resistance observed.

The above events may be referred to as the initial changes which occur in the blood in exercise and should be attributed to altered respiratory activity and may be presumed to occur without marked loss in efficiency. In the changes to be subsequently described, however, there is involved a diminution in the efficiency of the processes of the organism, and this onset of diminished efficiency has therefore been called fatigue. It must not be thought however that there is a sharp distinction between these two conditions. On the contrary, the diminution in efficiency is probably in progress from the beginning, but only becomes patent after a longer or shorter period dependent upon the individual system with which we are dealing.

The changes just discussed do not continue proportionally to the duration of the muscular effort. In these experiments, there has been noted the following tendencies of these factors, when the exercise is of long duration: The resistance of the erythrocytes increases, but at a diminishing rate, and in some cases tends to return toward the normal value; the changes in the corpuscular concentration of chlorides are comparable to those in resistance; the percentage saturation of the hemoglobin with oxygen decreases until it is less than at the start of the experiment; the bicarbonate content of the plasma falls at a diminishing rate; and as far as my experiments indicate, there is a decrease in the lactic acid concentration of the blood. This picture of the conditions prevailing in the blood in long continued muscular effort is only fragmentary, and unfortunately it was not possible to make the observation either on the same samples of blood or entirely on the same individuals. In so far as they are valid, however, they indicate an attempted readjustment of the organism to the new demands which have been made upon it; but as indicated particularly by the diminished saturation of the hemoglobin with oxygen and the tendency of the resistance of the red cells to decrease, the compensation has been incomplete and the efficiency with which the organism can meet the increased energy requirements is diminished. Here then is some evidence of fatigue.

RELATION OF RESULTS TO RESPIRATION.

Because of the current opinion that lactic acid is one of the most important factors in fatigue, the results obtained in my experiments are of some significance. In confirmation of Ryffel's results, it was found that the initial effect of severe exercise was to increase the lactic acid concentration in the blood. But long periods of exercise, e. g., running 15 to 20 miles at 6 miles an hour, resulted in a diminution in its concentration in the venous blood. This questions the importance of the rôle which it has formerly been thought to play in the fatigue of the intact organism. It is not the purpose of the present paper to consider the causes underlying the decrease in the lactic acid concentration of the venous blood in fatigue, but it does seem worthy of mention that its significance in what is commonly called "second wind" may be considerable.

As a tentative explanation of the rôle which the lactic acid might play in this connection we suggest the following: Granting the importance of the hydrogen ion concentration of the blood in the stimulation of the respiratory center, we may assume that the initial rise in the lactic acid concentration is in part responsible for the hyperpnea accompanying the first phase of exercise. When on the other hand, the lactic acid concentration is later diminished, this factor in stimulation is removed and the degree of ventilation is determined by the requirements of the active tissues.

After the experimental work had been completed I found a paper Manca published in 1895, entitled, "The Influence of Muscular Fatigue upon the Resistance of the Red Blood Corpuscles." He showed by qualitative estimation of the degree of laking that the resistance increased in exercise, and, notwithstanding the technic employed, was able to construct curves very similar to those obtained by me. The cause of this altered resistance he attributed either to a modification of the corpuscle itself or of the blood plasma. He reached no definite conclusion as to which portion of the blood was responsible for the increase in resistance, but he suggested that the work of Hamburger on the effect of acids and alkalies on the permeability of the corpuscles was probably of significance in this connection.

Hamburger in 1892 had decided from experiments that alkalies and acids, including carbon dioxide, altered the permeability of the corpuscles, but not their osmotic pressure. In 1897 he compared the volumes of red blood corpuscles from the jugular vein and the carotid artery respectively and found the volume of those in the venous to be greater than in the arterial blood. This phenomena he explained as follows: Under the influence of carbon dioxide, the proportion of "water drawing" substances increases more in the corpuscles than in the plasma. As a result of this, there exists a disturbance in osmotic equilibrium which is restored by the corpuscles drawing water from the plasma.

RELATION OF RESULTS TO CARDIO-VASCULAR CHANGES.

The effect of the gaseous changes in the blood upon the osmotic equilibrium between the corpuscles and plasma in exercise have been considered. The significance of these changes in relation to the organism as a whole will now be considered.

As indicated by the summary Table V it was found that the arterial blood after exercise had a lower content of carbon dioxide, a higher content of oxygen and hemoglobin, and a higher proportion of oxygenated hemoglobin. What do these changes signify? In the final analysis one may classify them all as the response made to the increased need for oxygen on the part of the active tissues.

The increased oxygen requirements of the tissues must be met by an increased supply of oxygen in unit time. In addition to the reflex nervous mechanism affecting cardio-vascular and respiratory changes which act in the interest of the active tissues, the importance of the following factors may be suggested. The activity of the working muscles probably results in the local production of metabolites which dilate the blood vessels of the active tissues. A redistribution of blood may result, which would lead to a diminished rate of blood flow through the medulla oblongata. An indication of the extent to which this redistribution may occur is given by the experiments of Stewart who found for example that the normal rate of flow through the hand was 12–13 grams per 100 c. c. of tissue. When one hand was contracted while the other remained quiet, the blood flow through the former was 15.4 gram compared with 4.9 gram through the latter. Assuming a normal metabolism of the cells of the medulla, the hydrogen ion concentration of the latter would rise, were the composition of the arterial blood unchanged, due to the inability of the reduced volume of blood to remove the products of metabolism as rapidly as they were produced. But an increased hydrogen ion concentration within the cells would be incompatible with the normal condition of the organism, and stimulation of the particular nervous tissue where the change occurred would result. More plainly, efferent impulses emanating from the respiratory center would result in increased ventilation until the blood entering the medulla had a concentration of carbon dioxide sufficiently diminished to remove the metabolites of the nerve cells and maintain them at their optimum hydrogen ion concentration.

Again, the oxygen supply per unit time may be met by more oxygen per unit quantity of blood without alteration of the circulation rate. Such an increase in the amount of oxygen per unit quantity of blood may be obtained by (1) increasing the amount of oxygen carried by the hemoglobin, or (2) increasing the amount of hemoglobin per unit quantity of blood without changing the percentage saturation. The most usual means of meeting the increased oxygen requirements is by an increase in the amount of blood supplied to the active tissues per unit time. This would not in itself necessitate a change in the oxygen content of the blood or of the blood pressure, which in turn is dependent upon the total volume of the blood, the capacity of the vascular system, the peripheral resistance and the output of the heart. The output of the heart is influenced by the venous inflow. The great initial rise in blood pressure in severe exercise is followed by a fall to more nearly a normal value. How do the various factors respond to make this possible notwithstanding the increased oxygen requirements of the tissues?

It is known that the velocity of the blood is directly proportional to the pressure and inversely proportional to the resistance at any one portion of the system, although a general lowering of the resistance without increased pressure can lead to a diminished velocity. The peripheral resistance in the muscles does diminish in exercise. What effect has this upon the capacity of the vascular system and upon the total blood volume? Experiments on changes in the blood volume in exercise have indicated an increase in the volume of the actively circulating fluid; but since there was considerable inconsistency in the magnitude of the results at times, one can not say to what extent this factor was influential in the resulting blood pressure. It is known that the heart rate increases but this would lead to an increased pressure only in case the venous flow increased. This may happen in view of the diminished peripheral resistance and the rhythmic contraction of the muscles. As has earlier been stated, the blood pressure in exercise must be the resultant of these factors. Though perhaps slight in itself the possibility of increased oxygen content of the blood should be also considered in an analysis of the means by which the increased oxygen needs of the tissues are met. Viewed from another angle, should not one also consider this ability of the blood to supply the tissues with their increased need for oxygen as an additional factor in the maintenance of the blood pressure at its uniformly constant level, even in conditions foreign to the usual state of the organism? Certainly were it not for this ability of the blood to aid in meeting the requirements of the tissues, the blood pressure must necessarily be higher than is usually the case.

In addition to the fact that more oxygen is carried per unit quantity of blood, the percentage oxygenation of the hemoglobin is also slightly greater. Barcroft has shown that the rate of reduction of hemoglobin is greater at the higher than at the lower degrees of oxygenation. Another point to be considered in this connection is the fact that the rate of reduction is also favored by an increase in temperature and that an increase in temperature accompanies muscular exercise. These facts though of only secondary importance in a consideration of the factors involved in supplying the tissues with an increased amount of oxygen, should nevertheless not be neglected in considering the mechanism of this increased supply.

Increased oxygenation of the blood per unit quantity is effected, in addition to increased ventilation, by increasing the amount of hemoglobin carried by unit quantity of blood. This is not great to be sure, and probably results from an increased number of cells per unit quantity of blood, but any increase would increase the oxygen carrying power without necessarily increasing the percentage oxygenation of the hemoglobin.

Another point of more than passing interest appears from the fact that there was a general tendency for the venous samples to have a lower hemoglobin content than the corresponding arterial samples before exercise and for the reverse condition to obtain after exercise. Merely as a possible explanation of this phenomenon, it is suggested that as the arterial blood from the left ventricle had just come from the lungs where in addition to losing carbon dioxide, it had also lost water, it was therefore slightly more concentrated than when it had left the right ventricle or the jugular vein, the particular source of the venous blood. On the other hand, the greatly increased salivation attendant upon exercise of the dogs may be responsible for a concentration of the blood quite overshadowing the concentration effected by the evaporation from the lungs. Analyses of the oxygen capacity during rest periods comparable to the periods of exercise indicated that either the oxygen capacity remained unchanged or tended to drop during the period of inactivity in the case of both the arterial and venous blood. Furthermore, when any difference existed between the arterial and venous blood at any one time that difference was in the direction of a lower oxygen capacity for the venous than the arterial blood.

The conditions which have just been described are those of the readjustment of the organism to the increased energy demands made upon it in the first stage of muscular effort, and before an appreciable diminution in the efficiency of the interacting processes occurs. It has not been possible to follow the course of the changes in the arterial blood throughout a period of extended muscular effort, but this has been done in the case of the venous blood. There, it was found that the increased oxygenation of the hemoglobin initially occurring, changes in time to a decrease in its oxygenation This implies increased oxygen utilization, diminished rate of flow, diminished oxygenation of the blood in the lungs or diminished affinity of the blood for oxygen. Since the exercise was maintained at a constant rate, it does not seem plausible that the first suggestion is the correct one. That the rate of flow may diminish is suggested by the fact that the blood pressure falls following the initial rise at the onset of exercise. No evidence is at hand which indicates that the oxygenation of the blood in the lungs is inadequate. That these adjustments of the organism to the new conditions of increased energy release can not be maintained, is evidence of diminished efficiency on the part of the cooperating processes. The inability to maintain this acceleration of processes and to keep them integrated as a unit comprises the present conception of fatigue.

To Prof. Frederic S. Lee for directing me to the problem of the physiology of fatigue, to Prof. F. H. Pike for constructive and helpful criticism in the development of the research, and to Prof. E. L. Scott, under whose immediate direction this work was performed, I am deeply and gratefully indebted.

SUMMARY.

1. Certain phases of muscular fatigue have been investigated with special attention to the gaseous and osmotic relationships in the blood of dogs.

2. Hemolysis in vivo occurs in untrained dogs after severe exercise.

3. The resistance of the red blood corpuscles to laking by hypotonic salt solutions is increased by exercise.

4. The carbon dioxide content of the blood is decreased in both arterial and venous blood by exercise.

5. The degree to which the hemoglobin is saturated with oxygen is increased in arterial and diminished in venous blood by exercise.

6. These changes in gases result in a migration of acids, of which Cl' is an example, into the plasma. A diminished osmotic pressure within the corpuscles results and is indicated by an increase in resistance to laking by hypotonic salt solutions.

7. Certain of these changes are modified by long continued exercise. This failure in the efficiency of the processes of the organism is regarded as fatigue.

8. The significance to the cardio-vascular and respiratory systems of the changes in the blood gases and the osmotic relationships is briefly considered.

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STUDIES ON THE TREATMENT AND DISPOSAL OF INDUSTRIAL WASTES

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5. THE PURIFICATION OF TOMATO CANNING WASTES

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STUDIES ON THE TREATMENT AND DISPOSAL OF INDUSTRIAL WASTES.

5. THE PURIFICATION OF TOMATO CANNING WASTES.

INTRODUCTION.

There is probably no class of industrial plants producing liquid wastes that is so widely distributed as the canning industry. Almost every section of the country has some branch of this industry, the extent of it depending upon the peculiar fitness of the soil or climate to grow some special kind or quality of fruit or vegetables. In some localities only one or a very few products may be canned, while at others, especially in the vegetable-growing districts, "full line" canneries are operated either throughout the year or during the entire growing seasons.

When canneries are located on bodies of water of sufficient volume to dilute the wastes so that nuisances do not result, no trouble is experienced in disposing of the wastes. Where, however, the plants are situated inland and watercourses are not available to carry away the wastes some method of treatment is required. The methods that have been proposed for treating the various kinds of cannery wastes have usually followed the simpler methods used in treating domestic sewage. Some of the treatment devices have been partially successful while others have failed completely and still others have taken advantage of purely local conditions such as favorable soil for broad irrigation or the use of natural gravel beds.

In the summer of 1914 Dr. W. D. Bigelow, chemist of the National Canners' Association, requested the Surgeon General of the United States Public Health Service to detail a sanitary engineer to study methods of treating cannery wastes. The request was granted, as Congress had, by act of August, 1912, directed the United States Public Health Service to study "the pollution, direct or indirect, of the navigable rivers of the United States," and industrial waste treatment was being studied under this act at the time Dr. Bigelow made his request.

The particular problem that gave rise to the request for assistance in developing methods for treating cannery wastes was a serious nuisance existing at that time as the result of the Fort Stanwix Canning Co. discharging its waste into a small stream near Farnham, N. Y. This was a "full line" company that began packing peas in June and finished the season with corn in the fall.

Before the Fort Stanwix Co. appealed through the National Canners' Association to the United States Public Health Service for assistance they had taken up the question of treating their wastes with the chief engineer of the New York State department of health and with a firm of consulting engineers in New York City. These engineers had reported that there was no satisfactory method known for purifying canning wastes, and they recommended that the Government undertake a series of tests for developing satisfactory and economical processes of treatment.

When the request for assistance came, the season of 1914 was too far advanced to design and build a testing station to work on the wastes for that year, but the canning company requested that all the information that was possible to obtain should be collected in order that the company might have some data on which to base the design of a treatment plant that would give some relief the following year. The writer was ordered to proceed to the Fort Stanwix Canning Co. on September 10, 1914, and he remained there for five weeks. During this time small scale tests were made with improvised filters, and, on the basis of the results thus obtained, plans were prepared during the winter of 1914–15 for a treatment plant to treat all the wastes from the cannery. There was an understanding, however, that the entire treatment plant was to be operated as a testing station, and it was to be remodeled if satisfactory results were not obtained.

The construction of the treatment plant was started in May of 1915, and was about one-half completed when all the cannery buildings were destroyed by fire. No further attempt was made to continue the tests that year.

In the summer of 1916 the equipment of a testing station that had been in operation at a strawboard mill at Noblesville, Ind., became available, and it was decided to use this equipment at the Colter Canning Co., Amelia, Ohio, for developing methods for treating tomato-canning wastes. It was the intention at that time to use the results obtained at this place as the basis for designing a testing station for treating the wastes from a "full line" cannery. With the entrance of this country into the war, however, all research work of this character was discontinued in the spring of 1917, and has not been taken up again owing to the lack of sufficient appropriations to carry it along. Since the studies of industrial waste treatment were to be discontinued temporarily, it seemed advisable to publish the data collected on the treatment of tomato canning wastes for the benefit of the canneries particularly interested in the purification of this waste.

Associate Sanitary Engineer H. H. Wagenhals supervised the construction of the testing station and assisted in preparing the data for this report.

Sanitary Bacteriologist C. T. Butterfield had charge of the operation of the testing station and Sanitary Bacteriologist E. J. Theriault was responsible for the chemical analyses made.

Mr. James R. Hicks, of the Colter Canning Co., took an active interest in the tests and supplied the data pertaining to the operation of the cannery and the number of cans of tomatoes packed.

PREVIOUS INVESTIGATIONS.

A careful search of the literature has failed to disclose more than a very few references or articles describing treatment plants for purifying tomato canning wastes. There is a short article in the Annual Report of the New Jersey State Board of Health for 1910, and in later reports plants are mentioned, but no detailed results of operation are given. The 1910 report gives an article by F. E. Daniels, chemist and bacteriologist for the State board of health, on the treatment of tomato canning wastes. His conclusions may be summed up as follows:

1. It would not be advisable to separate and treat wastes from different sources owing to the fact that all the wastes contain some crushed tomatoes, and that too much extra apparatus would be required.
2. "Screening both through fine wire screens and through cheesecloth was found to have practically no effect on the putrescibility."
3. Chemical precipitation, using lime, iron sulphate, calcium phosphate, clay, alum, and combination of these substances, failed to give a clarified liquor which was stable for more than a few hours.
4. It was found that storage of waste overnight gave a liquor almost free of turbidity, but the settled waste required considerable dilution with water to obtain stability.
5. "Two small sand filters were constructed, but owing to limited size or lack of time for maturing, the operation was not satisfactory."
6. "Summing up, I have come to the conclusion that for preliminary treatment a sedimentation process will, perhaps, be the best. A tank holding about a day's flow provided with suitable baffles should give the required separation of solids from liquids."
7. "Where no stream is available, as at inland factories, I recommend that a small piece of ground be set aside for the purpose and thoroughly plowed and worked up to receive the dose of clear liquor. It will be better to alternate the application upon different parts of the ground."

In addition to the data contained in the Annual Report of the New Jersey State Board of Health for 1910, there are two other references in later reports to canning factories that use sedimentation and broad irrigation. The report of the inspections of these plants show that the results obtained were not entirely satisfactory.

There is an article in the University of Illinois Bulletin[1] of May 18, 1914, which gives the results of some studies made to treat wastes from canning corn and peas.

Although these wastes bear no direct relation to those from tomato canning, the reference is included because the final recommendations for their treatment were similar to those made by Daniels in his report already referred to. The conclusions were that the wastes from packing peas and corn could be disposed of at the factory in Washington, Ill., by removing the solid matter by a series of one-half inch screens and applying the screened effluent by siphons to land properly prepared. It was recommended that the waste be applied to the land at a rate of 40,000 gallons per acre per day.

RÉSUMÉ OF RESULTS.

A testing station was operated during the tomato-canning season of 1916 at the Colter Canning Co., Amelia, Ohio. The equipment used in the tests was originally purchased for similar studies in connection with the treatment of strawboard wastes, and it was necessary, therefore, to plan the work at Amelia to fit in with the tanks that were available. This was not, however, considered disadvantage, since it was possible to design the plant so as to utilize the old equipment as advantageously as any new equipment that could have been purchased.

Volume of wastes.—The canning season of 1916 was one of the poorest in several years, so that the flow data are not as representative as might be desired. In addition, consideration must be given to the fact that the canning company's water supply was limited. Careful measurements were made, however, on practically all days that tomatoes were packed. These measurements are given in Table No. 1. The average number of gallons of waste per No. 3 can of tomatoes was, for all measurements taken, 0.56. In arriving at this figure there were included the results of two days at the close of the tests on which readings were obviously too high and one at the beginning, when the reading appears to have been too low. Omitting the three results, the average becomes 0.43.

In the studies made by Daniels[2] it is stated that for 50 tons of canned goods there were produced 17,200 gallons of liquid wastes. Converting the 50 tons to No. 3 cans of tomatoes there are 50,000 cans. Computing the volume of waste that would have been produced had the corrected average found in our tests been used, the result would be 21,500 gallons.

The average that has seemed to be the fairest one to use is that derived from using all the measurements after making an allowance

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[1] Water Survey Series No. 11, Annual Report for 1913; abstract of thesis by Duane Englis on "The investigations on the disposal of canning factory wastes at Washington, Ill."

[2] Annual Report of State Board of New Jersey, 1910.

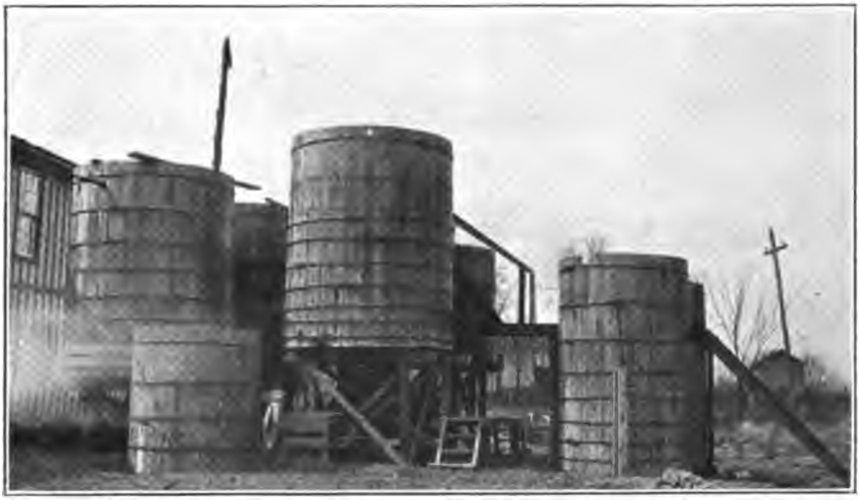

FIG. 1.—TESTING STATION AND CANNERY.

of 0.06 gallon per can for the high results of the last two days of operation. The average, therefore, that has been used throughout the report is 0.50 gallon of waste per No. 3 can of tomatoes packed.

Sampling.—Samples of the raw waste were taken from a small pump well (P), in figure 2, located just outside the cannery building, which received all wastes except the cores and skins. This sampling point may be open to the criticism that the waste was partially settled before sampled, and that the true sample should have been taken from the drain discharging into the well. The selection of the pump well was made because the flow from the cannery was too irregular to obtain samples from which to composite a representative sample. A sample of the waste mixed in the well more nearly approached a composite than could samples taken any other way. When the cannery was operating at full capacity, the pump well was emptied frequently, but when the tomatoes came in slowly the waste was stored in the pump well and in the settling tanks in order that the filters might be operated continuously.

Whatever changes took place in the waste in the pump well would have taken place in the tanks, so that from the standpoint of secondary treatment and final effluent, the storing of the waste prior to treatment in the tanks had no effect on the operation of the testing station. All of the suspended matter except the cores and skins of the tomatoes was pumped into the settling tank.

Tank treatment.—Referring to figure 2, it will be observed that the raw waste was pumped to a small "stilling" tank, from which it overflowed into the settling tank and thence into the Imhoff tank through a 4-inch submerged inlet and outlet pipe. This arrangement for settling the waste had to be adopted in order to make use of tanks already available, but it would not be recommended in the design of a full-size treatment plant. It is not believed, however, that any other form or size of tank would have removed a higher per cent of the suspended matter or had any other effect that would have altered the result obtained from the primary and final filters.

In treating tomato canning waste the principal function of tank treatment is to remove suspended matter and to permit the waste to sour. The suspended matter results given in Table No. 2 show that the tanks consistently removed a very high per cent of suspended matter on all days samples were taken but one. This result represented the last waste pumped, which contained mostly water and was not comparable to those obtained when the tomatoes were being packed. The reaction of the raw and settled waste is given in Table No. 10. The results given in this table indicate that tomato waste reaches a maximum acidity in a very short time. This is indicated by the fact that, in the two analyses recorded, the free CO_2 and the weak organic acids were practically the same in the raw waste as in the effluent from the Imhoff tank. The high results for the raw waste are due to the fact that it was not possible to pump all the waste from the pump well. The fresh waste coming in was, therefore, mixed with the soured waste remaining in the well, and consequently was seeded with large numbers of bacteria which produced the acidity and free CO_2 found.

The acidity of ripe tomatoes is due to the presence of citric acid. This acid, however, is readily converted into lactic acid, and it is this change that is referred to when tomatoes begin to spoil. The complete further conversion of the lactic acid to lactates is one of the objectives of treatment. This subject will be further discussed in connection with the results obtained from the cinder and the sand filters.

The organic nitrogen of the raw waste was reduced in the tanks while the ammoniacal nitrogen increased. The oxygen consumed values were also greatly reduced by tank treatment, but the 10-day oxygen demand averaged practically the same for the tank effluent as for the raw waste.

This difference in the removals of the oxygen consumed and oxygen demand contents is readily explainable when consideration is given to the constituents which enter into these analyses. Oxygen consumed represents the carbonaceous material, which, being largely in suspension, is removed by the tank treatment. The oxygen demand in 10 days, on the other hand, was not materially affected by the removal of the suspended matter, so that the results of this determination showed but slight change due to tank treatment. The effect of suspended matter on the oxygen demand determination is discussed in detail under the section giving the analyses of the raw waste and effluent from Imhoff tank.

The effluent from the Imhoff tank was applied to two cinder filters, each 8 feet in diameter and 4½ feet deep. These filters were installed with the expectation that they would effect enough purification so that the sand filters receiving the waste from them could complete the oxidation of the organic matter at reasonable rates of operation.

The length of time the waste was in the tanks before being applied to the filters was indefinite owing to irregular operation of the cannery, but all the evidence indicated that after about eight hours' storage the change in the composition of the waste was negligible so far as affecting the treatment on primary and secondary filters. A further discussion of the results and rates will be found in the body of the report and in the conclusions.

Primary filters.—Cinder filter No. 1 was operated at a net rate of approximately 83,000 gallons per acre per day and No. 2 treated waste at the rate of about 123,000 gallons. The results obtained were practically the same for both filters. The average suspended matter in the effluents of the two filters for the entire canning season was only about 50 per cent of that in the influent to the filters. Comparing the average organic and the ammoniacal nitrogen results from the filters with similar figures for the influent, it is found that while both these constituents were reduced, the reduction was not great. The average oxygen consumed results for the two effluents were practically 50 per cent lower than corresponding results for the influent. The real value of the cinder filters as a preliminary treatment for sand filters is best illustrated, however, by the oxygen demand results. Filter No. 1 averaged for all determinations a reduction over the influent of 69 per cent and filter No. 2 gave a corresponding reduction of 62 per cent.

The results given above show quite clearly that the cinder filters can be relied upon to effect a reduction of at least 50 per cent of those constituents in settled tomato waste that use up oxygen and an equal per cent removal of the suspended matter. These reductions brought the strength of the waste down so that the sand filters could oxidize all the organic matter in the waste and thereby produce a stable effluent.

When the testing station was closed down at the end of the canning season the cinder filters were examined to learn to what extent clogging had taken place, and also the nature of the deposited material. For a depth of 12 inches in filter No. 1 and 18 inches in No. 2 there was a noticeable deposit of grayish material. It had a peculiar sweetish odor suggestive of the waste in the settling tanks, but not offensive. The material near the surface of the filters was somewhat slimy, but lower down it was granular and there were no growths of any kind on the cinders. Below the top layers of 12 inches and 18 inches in the two filters the beds were relatively free of clogging material and there was but little foreign matter in the underdrainage except near the outlet where a whitish growth had developed. This growth extended back from the outlet about 12 inches, but it did not appear to have any effect on the results except to increase the suspended matter when it broke loose from the stone. On the whole, the cinder filters were considered to be in excellent working condition at the close of the tests. There was no pooling on the surface and the condition of the clogging material did not indicate that the beds were filling up with organic material that would have eventually ruined them as preliminary treatment for sand filtration.

Secondary filters.—Four sand filters were operated throughout the period of the tests. Nos. 1 and 3 received the effluent from cinder filter No. 1 and Nos. 2 and 4 the effluent from cinder filter No. 2.

Sand filter No. 1.—This filter was operated from September 5 to November 3 at an average net rate of 86,000 gallons per acre per day. During the earlier part of the tests intrification was absent, the dissolved oxygen was low, and samples diluted with equal parts of water were stable for only a comparatively short time. Beginning on September 28, however, the nitrification and dissolved oxygen increased and the undiluted samples were stable for more than 96 hours. The suspended matter in the influent was reduced to traces, or less than 15 parts per million in the effluent.

When this filter was closed down at the end of the canning season there was on the surface a thin hard layer consisting of sand bedded in organic matter washed from the cinder filter, but below the top 3 or 4 inches, the sand was clean and bright and had no offensive odors.

Sand filter No. 2.—This was the largest of the sand filters, the diameter being 8 feet. The average net rate for the entire time the filter operated was 79,000 gallons per acre per day. This filter showed some nitrification at the start only to lose it a few days later. On October 3, however, nitrites and nitrates were found in the effluent and from that time on nitrification was very active. The dissolved oxygen began to increase shortly after nitrification became established and the undiluted samples were stable for 96 hours in practically all samples. The suspended matter in the effluent is recorded as traces—that is, less than 15 parts per million.

An examination of this filter at the close of the tests showed the same conditions found in No. 1. There was a small amount of clogging at the surface, but below this the sand was practically free from foreign matter.

Sand filter No. 3.—This was a small filter 5 feet in diameter which received the effluent from cinder filter No. 1. The average net rate on this filter was 88,000 gallons per acre per day. Nitrification began in this filter on September 13, but it did not become active until a few days before October 13. The dissolved oxygen was fairly high during all the time the filter was operated and the stability was more satisfactory in the earlier part of the tests than for filters Nos. 1 and 2. As was the case in the latter two filters, there was practically no suspended matter in the effluent of this filter at any time.

When this filter was closed down the same conditions were noted in the surface layers and below that have already been described for the other filters.

Sand filter No. 4.—This filter was an exact duplicate in size of No. 3, but it received the effluent from cinder filter No. 2 instead of No. 1. The cinder filter effluent was applied to this filter at an average net rate of 74,000 gallons per acre per day. Nitrification developed in about the same time and to approximately the same extent as it did in the other filters already discussed. Likewise the stability of the effluent and the suspended matter it contained followed very closely the results from the other filters. The physical condition of the bed was not different at the close of the tests from that found in the examination of filters 1, 2, and 3.

It is not believed that the sand filters would have given the results found if the effluents they received had not been previously treated on the cinder filters. As the plant was operated, the cinder filters treated the settled waste at 83,000 and 123,000 gallons per acre per day, respectively, for filters Nos. 1 and 2, and the sand filters were operated at rates averaging more than 75,000 gallons per acre per day.

Analytical methods used.—The analytical methods used for the chemical and bacteriological work were, with the exception of the oxygen demand determination, those recommended by the Standard Methods of the American Public Health Association for 1917. The following determinations were made according to the procedure outlined.

The organic nitrogen and free ammonia were determined by the direct process. A sample of the waste or effluent was digested with sulphuric acid until the organic matter was reduced. It was then diluted, neutralized, and a portion of the digestate nesslerized and read without distillation. The free ammonia or ammoniacal nitrogen was found by adding a small amount of sodium hydrate and copper sulphate to the sample, allowing the precipitate to settle, and then pipetting off an amount of supernatant that gave a proper reading when nesslerized.

The nitrates were determined by the reduction process and the nitrites by the method outlined in Standard Methods.

The alkalinity was obtained by using methyl orange as an indicator and the acidity by phenophthalein in a boiling solution, titrating with potassium hydrate.

The oxygen consumed of the raw waste and effluents was determined by immersing samples containing sulphuric acid and an excess of potassium permanganate in boiling water for 30 minutes. The permanganate remaining in the sample at the end of 30 minutes was titrated according to the procedure given in the Standard Methods to find the amount used by the sample.

The oxygen demand was obtained by the excess oxygen method. Samples were diluted with water of known dissolved oxygen content and incubated at 20° C. for 24 hours, 5 and 10 days, and the loss of oxygen was determined. This method[3] was developed at the Public Health Laboratory at Cincinnati from the technique used by other laboratories.

Since the putrescibility tests were carried out at the cannery and it was not feasible to use incubators, the results were reported as the number of hours required to reduce methylene blue in samples stored at room temperature. On the average, this was about 65° F., except during the warm months, when the average was approximately 75° F.

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[3] Theriault and Hommon. The determination of Biochemical Oxygen Demand of Industrial Waste and Sewage. Public Health Bulletin No. 97.

The dissolved oxygen was determined by the method given in Standard Methods.

The bacteriological results were reported as the total count on gelatin at 20° C. after 48 hours' incubation, and on agar at 37° C. at 24 hours. All *B. coli* results were confirmed.

DESCRIPTION AND OPERATION OF TESTING STATION.

The testing station was located in the rear of the cannery. The arrangement of the tanks and filters is shown in figure 2.

PUMPING EQUIPMENT AND PUMP WELL.

The wastes from the cannery floors were collected in one central channel which discharged into a rectangular concrete basin located just outside the building. This basin was 5 feet long by 4 feet 6 inches wide and 6 feet deep to the overflow pipe. At the bottom of the collecting basin there was located a 2-inch centrifugal pump belt connected to a small steam engine set inside the cannery. There was not enough waste to operate the pump continuously, so that it was necessary to start the pump whenever the basin was full or when there was not sufficient waste in the tanks to supply the filters. When the cannery was packing tomatoes every day the waste was pumped at regular intervals, but on those days when no tomatoes were received the basin was used for storage to supplement the settling tanks in order that the tests might not be interrupted. As will be shown later the filters were operated 24 hours a day.

The discharge line from the pump was a 2-inch pipe to the settling tank.

SEDIMENTATION TANKS.

Settling tank.—This was a round wooden tank 8 feet in diameter and 10 feet deep supported on posts about 3 feet above the ground. The waste was discharged into a small "stilling" chamber 1 foot 6 inches by 2 feet in plan and 2 feet deep with an overflow 6 inches below the top of the tank. This chamber was contained within the main tank. The outlet from the settling tank was diametrically opposite the inlet. It was located 4 feet from the top and consisted of a 4-inch pipe connected to the Imhoff tank. The level of the waste in the tank varied from a few inches to 2 feet above the outlet pipe, depending upon the regularity of operation of the cannery and the amount of waste used by the filters at night. It will be shown later in a discussion of the Imhoff tank that the outlet from the latter tank was 2 feet above the 4-inch pipe that connected the two tanks together.

There were no baffles in this tank and no other connections to it except a 4-inch sludge line which extended through the side a few inches above the bottom.

Imhoff tank.—This tank was an exact duplicate of the settling tank in size but contained a galvanized-iron baffle which separated the sludge compartment from the flow section. The waste entered from the settling tank about 4 feet below the top, passed around the gas funnel of the separating baffle and out of the tank on the side opposite to and 2 feet below the inlet to the settling tank.

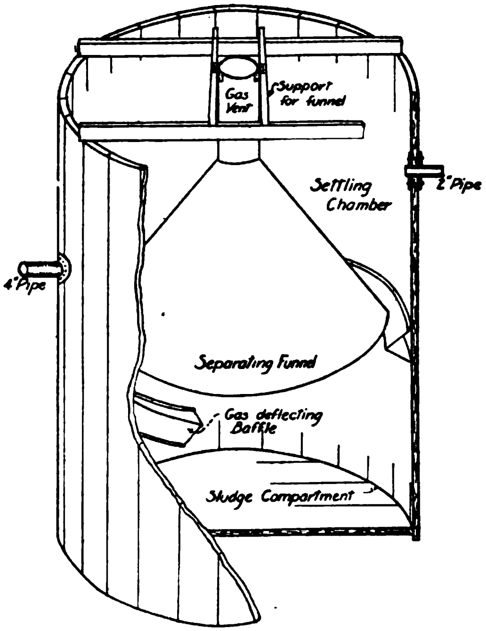

FIG. 2.—Imhoff tank at Amelia, Ohio.

The separating baffle of the Imhoff tank consisted of a cylindrical gas vent section 12 inches in diameter and 2 feet deep and a flaring or apron-shaped section that extended from the cylindrical section at the top down 3 feet to within about 6 inches of the sides of the tank. Around the inside of the tank just below the lower edge of the apron of the separating baffle there was a V-shaped galvanized-iron trough or baffle nailed to the tank with the point of the wedge extending out in the tank. The inner edge of this baffle overlapped the outer edge of the separating baffle, thus forming a trap to prevent sludge, carried up by the gas from the bottom of the tank, from entering the waste flowing through the tank.

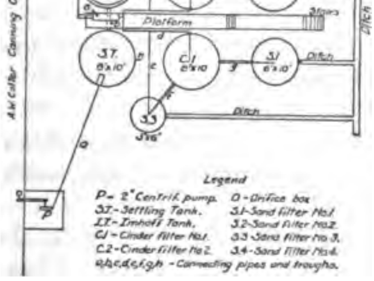

FIG. 3.—Sketch of experimental plant at Amelia, Ohio.

The settling and Imhoff tanks were originally used in the tests made for treating strawboard wastes and the section of the Imhoff tank, as given in the report of these tests, is reproduced in this report to show how the tank was constructed. (Fig. 2.)

Near the bottom of the Imhoff tank a 4-inch pipe with valve was connected to remove the sludge.

The outlet from the Imhoff tank was a 2-inch pipe located on the opposite side from the inlet and 2 feet down from the overflow of the "stilling" or inlet tank. When the two tanks were full there was provided 2 feet of waste in each tank which was sufficient to operate the filters during the night. The 2-inch discharge pipe was connected with an orifice box set between the settling and Imhoff tanks and the rate of discharge through this line was controlled by a 2-inch gate valve set just outside the orifice box, and a $\frac{3}{4}$-inch float valve located inside. The waste was measured over a V-shaped weir set in the orifice box at the opposite end from the inlet. The weir box was 2 feet 6 inches by 10 inches in plan and 12 inches deep. The waste was discharged from the orifice box onto two cinder filters each operating independently of the other with respect to method of dosing and the volume of waste treated.

When there was more waste discharged from the cannery than could be treated on the filters or stored in the tanks and pump well, the excess was siphoned from the Imhoff tank to land adjoining the testing station. The land used for this purpose was clay, and no attempt was made to remove the weeds or work the soil up by plowing and harrowing.

PRIMARY FILTERS.

Cinder filter No. 1.—This filter was contained in a round wooden tank 8 feet in diameter and 10 feet deep. A concrete bottom was laid in the tank sloping in two directions from a ridge across the center. This permitted the filtered waste to be divided so that one portion could be treated on sand filter No. 1 and the other on sand filter No. 3.

The filtering material in this tank was composed of 4 to 6 inches of coarse cinders carefully placed over the bottom and 4 feet of washed cinders above the coarse material of the underdrainage.

The effluent from the Imhoff tank was applied to this filter and distribution was effected by means of two shallow troughs nailed together in the form of a cross. As the bed was not dosed by a siphon and the influent, therefore, not flushed over the surface, it was necessary to change the position of the distribution trough about once in two weeks.

There were two outlet pipes from this filter, both flush with the bottom, which supplied sand filters Nos. 1 and 3 with waste. These pipes, which were 2 inches in diameter and 6 inches long, discharged the effluent into troughs that extended to the center of the sand filters.

Cinder filter No. 2.—This filter was constructed in a similar manner in every way to No. 1, but the tank containing the cinders was

8 feet in diameter and 6 feet deep. The influent came from the Imhoff tank and the effluent was applied to sand filters Nos. 2 and 4 by a system of piping and troughs similar to that used for sand filters Nos. 1 and 3.

The rates on the cinder filters were controlled by a float valve in the orifice box and valves located in the lines leading from the orifice box to each filter. The float was adjusted to allow a flow to pass through the valve equal to the volume to be treated on the two filters, and the amount treated on each filter was regulated by three-fourths inch valves set in the lines just outside the filters.

SECONDARY FILTERS.

Sand filter No. 1.—This was a round wooden tank 6 feet in diameter and 10 feet in depth with a concrete bottom which sloped to an outlet flush with the wooden floor of the tank. Over the concrete bottom there was placed 5 feet of sand. There was no coarse underdrainage placed over the bottom of this filter except a few large stones around the outlet. All of the other sand filters had a layer of coarse and fine stone under the sand. Experience with growths around the outlet of this filter indicated that underdrainage of coarse material of some kind is advisable to insure satisfactory operation.

The influent which came from cinder filter No. 1 was applied to the surface of the filter by means of shallow troughs of similar construction and arrangement as those described for the cinder filters. These troughs were shifted around the bed about once every two weeks so as to utilize all of the surface area.

The sand used in this filter as well as all of the others, including the sludge filter, was obtained locally and was called washed Ohio River sand. It was practically free of all foreign material, especially clay, and had an effective size of 0.40 mm. and a uniformity coefficient of 1.35. This sand was of about the same size as that ordinarily used for building construction purposes.

Sand filter No. 2.—This filter consisted of a round wooden tank 8 feet in diameter and 10 feet deep in which was placed a concrete bottom sloping to the outlet drain. Over the bottom there was placed an average of 6 inches of coarse and fine gravel underdrainage and above this 4½ feet of washed river sand. The influent to this filter came from cinder filter No. 2, and it was applied to the bed and distributed over its surface in a manner similar to that already described for the other filters.

The amount of waste discharged from cinder filter No. 2 onto this bed was regulated by a valve on the outlet from the cinder filter.

Sand filters Nos. 3 and 4.—These two filters were identical in size, shape, and construction and differed only in the source of the influents applied to them. The influent to No. 3 came from cinder filter No. 1, while that for No. 4 from cinder filter No. 2. Each containing tank was 5 feet in diameter and 6 feet deep, and had a concrete bottom sloping to the outlet drains. Over the bottom of each tank there was placed an average of 6 inches of coarse and fine stone and above this 4½ feet of washed river sand.

The apparatus and method of applying the waste were the same as those already described.

All the filters were operated 24 hours a day with the exception of Sunday and such other days when there was not sufficient waste stored in the pump well and settling tanks to keep the filters going because of interruption of canning operations. Ordinarily, however, the stored waste was sufficient to run the filters during the days when there were not enough tomatoes coming in to operate the cannery.

The rates on the different filters were controlled by weir readings in the orifice box, and by hourly measurements of the amount of waste actually going onto the filters. There was, however, no attendant at the plant at night, so that it was necessary to assume an average rate for the night period whenever the first reading of any given day was below or above the desired rate. As a rule, the rate maintained during the night was fairly uniform, the cases being rare when the rate dropped as low as 50 per cent.

On the days samples were taken for complete chemical analysis hourly portions were collected from each device and pooled. Special samples for putrescibility were taken at 2 p. m. and those for bacteriological analysis at 12.30 p. m. The latter samples were analyzed the same day they were taken, usually within four hours after collection.

The surfaces of the sand filters were raked whenever the sand became hard and compacted, but this was required only twice during the tomato canning season. It was not necessary to disturb the surface of the cinder filters during the time the tests were in operation. It was necessary, however, to flush out the underdrains of the cinder filters twice to remove growths that formed in the outlet pipes and on the coarse stone, and the same procedure was required to clean out similar growths on the coarse stone around the outlet of sand filter No. 1.

Sludge beds.—Two of these beds were prepared, each 10 feet by 10 feet in plan and 16 inches deep, inclosed by 2-inch rough planking. The bottom of each bed was graded so that the waste filtered from the sludge would follow the slopes to one of three 4-inch farm tile drains which discharged into a main drain along one side of the bed. Over the tile there was placed a 6-inch layer of coarse cinders and above this a layer of screened cinders, averaging 12 inches deep. Resting upon the cinders was a 4-inch layer of sand of the same quality as that used in the sand filters already described.

It was not found necessary to apply sludge to these beds while the testing station was in operation, but when the plant was shut down all the sludge in the tanks was run onto them. Wooden troughs were used to carry the sludge from the tanks to the sludge beds and no difficulty was experienced in getting the sludge to run on a 5 per cent grade.

TREATMENT OF THE WASTES.

The testing station was operated throughout the tomato canning season. The cannery began to operate a few hours a day on September 7, but did not run with any degree of regularity until the 12th. Toward the close of the season there was another period when the operation was irregular. On account of the very short time the tests could be run it was necessary to obtain as many results as possible and to determine the efficiency of the devices originally installed rather than attempt to make changes in the testing units.

VOLUME OF WASTES.

The liquid waste from the cannery was collected in a pump well adjacent to the rear wall of the building and then pumped into the settling tank. The skins, cores, and other coarse material were collected in a concrete pit just outside the cannery and hauled away in wagons.

TABLE No. 1.—*Number of cans packed, volume of waste per can of tomatoes, and waste disposed of by irrigation.*

Date.	Total No. 3 cans packed.	Waste (gallons).		
		Total.	Applied to soil.	Per No. 3 can of tomatoes.
1916.				
Sept. 12	8,665	1,635	1,035	0.19
Sept. 13	7,050	2,610	2,075	.37
Sept. 15	9,602	2,985	2,260	.31
Sept. 16	5,728	2,235	1,780	.39
Sept. 19	3,429	1,320	375	.39
Sept. 20	4,680	2,020	940	.43
Sept. 23	3,562	1,680	315	.47
Sept. 26	2,695	1,135	1,050	.42
Sept. 29	2,640	1,340	440	.51
Sept. 30	3,093	1,340	1,005	.42
Oct. 3	3,445	1,535	....	.45
Oct. 6	2,543	765	815	.30
Oct. 7	1,882	1,010	565	.54
Oct. 10	2,420	1,595	565	.66
Oct. 14	3,062	1,120	565	.37
Oct. 18	1,468	1,680	....	1.14
Nov. 1	756	945	....	1.25

It was not practicable to measure the waste as it was discharged from the cannery because of the small amount flowing at times, but it was a simple matter to measure the rise in the settling and Imhoff tanks after each pumping. In Table No. 1 there are given data covering the volume of waste discharged from the cannery for No. 3 cans of tomatoes, together with data showing the amount of waste applied to land.

The volume of waste per No. 3 can of tomatoes packed varied from 0.19 gallon on September 12 to 1.25 gallons on November 1. In considering these figures, however, the fact must be kept in mind that as the season of 1916 was a poor one the cannery did not operate regularly. Another factor which might have had some bearing on the total volume of waste was that the canning company had a limited water supply, and this may have tended to keep down the water used for washing floors, etc. The average of all the measurements is approximately 0.50 of a gallon of waste per No. 3 can of tomatoes packed. This figure includes the low value for September 12 and the high results for October 18 and November 1. As these extremes tend to balance each other, it is believed that 0.50 gallon is a fair average for the amount of waste that can be expected under normal operation of a tomato cannery packing No. 3 cans.

The waste applied to the soil has no particular significance except as showing that this waste even after souring can be disposed of on land without injuring the productivity of the soil or creating a nuisance. The strip of ground to which the waste was applied was about 75 feet in diameter and the vegetation (mostly weeds) growing on it did not seem to be affected in the least.

CHARACTER OF THE RAW WASTE.

Composite samples of the raw waste were taken from the discharge pipe of the pump whenever it was operated. Strictly speaking, however, the raw waste samples did not represent the waste as discharged from the cannery drain, as it was collected in a pump well and held there until the well was almost full before being pumped out. The results of the analyses of the raw waste samples, together with those from the Imhoff tank, are given in Table No. 2.

TABLE NO. 2.—*Results of analyses of influent and effluent of Imhoff settling tank.*

[Results in parts per million.]

Date.	Influent (raw sewage).							Effluent.						
	Suspended matter.	Nitrogen as—		Oxygen consumed, 30′ at 100° C.	Oxygen demand 20° C.			Suspended matter.	Nitrogen as—		Oxygen consumed, 30′ at 100° C.	Oxygen demand 20° C.		
		Organic.	Ammoniacal.		24 hours.	5 days.	10 days.		Organic.	Ammoniacal.		24 hours.	5 days.	10 days.
1916.														
Sept. 7	....	....	....	....	....	....	....	108	86	....	274	....	....	....
Sept. 8	....	....	....	....	....	....	....	165	104	....	190	....	....	....
Sept. 11	....	....	....	....	....	....	....	260	128	....	260	....	....	....
Sept. 13	....	....	....	....	....	....	....	....	150	....	380	....	....	....
Sept. 26	690	168	110	380	290	....	4,800	300	176	125	335	520	5,120	6,080
Sept. 28	2,880	368	70	2,600	....	....	....	360	144	77	360	....	....	....
Oct. 3	6,720	360	110	1,040	1,410	7,500	8,550	500	210	115	380	660	5,500	5,900
Oct. 5	2,320	360	95	3,440	....	....	....	330	220	140	340	....	....	....
Oct. 13	3,960	360	75	2,550	2,600	6,800	8,000	360	210	110	520	1,330	5,800	6,200
Oct. 17	580	280	105	960	....	....	....	340	220	125	400	....	....	....
Oct. 19	....	....	....	....	1,550	4,250	5,100	490	220	130	380	900	5,200	5,800
Oct. 24	2,200	210	73	420	850	3,500	4,000	210	210	115	320	900	5,300	6,000
Oct. 26	2,240	210	43	1,160	....	....	....	280	220	110	480	....	....	....
Oct. 30	1,680	208	90	420	1,550	3,800	4,900	320	200	125	320	1,600	4,700	5,200
Nov. 3	350	176	60	680	1,100	3,470	3,800	440	208	125	400	1,100	4,200	4,600

The high suspended matter results for the raw waste were due to tomato seeds and small pieces of pulp and skins. These also account for the high results for organic nitrogen and oxygen consumed. The most important results, however, are those for oxygen demand as they best indicate the effect of the wastes upon any receiving body of water.

The strength of the waste can most readily be stated by a comparison with domestic sewage. This has an average 10-day oxygen demand of about 160. Comparing this with the corresponding values for tomato wastes, as given in Table No. 2, it is found that the waste is from 25 to 50 times stronger, with an average of 33.

The total volume of waste from a tomato cannery is, however, relatively small, so that, even though it be concentrated, it can be disposed of without nuisance if a stream of any considerable size is available as an outlet. By again comparing the waste with domestic sewage, it is possible to arrive at a dilution factor on the following basis:

For sewage, a flow of 5 cubic feet per second per 1,000 population has been considered sufficient water for satisfactory disposal without causing any nuisance. Allowing 100 gallons of sewage per capita, a flow of 5 second-feet is sufficient for 100,000 gallons of sewage. As a given volume of tomato waste is equivalent in strength to 33 times an equal amount of sewage, the 5 second-feet should receive only 3,000 gallons of this waste. From the figure of 0.5 gallon of waste per No. 3 can of tomatoes, as obtained in these tests, the 5 second-feet flow could take the wastes from 6,000 such cans. Converting this ratio, the dilution requirements may be stated as 180,000 gallons per eight hours operation of a cannery packing 1,000 No. 3 cans in that time.

SEDIMENTATION.

The waste was pumped from the pump well to the settling tank, and from there flowed through a submerged pipe to the Imhoff tank. The length of time the waste remained in these tanks depended upon the operation of the cannery. When tomatoes came in regularly every day the storage period was probably around 12 hours, but at other times the detention period extended to 24 hours, and in a few cases to 48 hours. Since, however, the chemical analyses were fairly uniform for all the determinations made, it has been assumed that the storage period beyond a certain time did not materially affect the operation of the filters. This subject will be discussed in detail in the conclusions and under the plant recommended.

Referring to Table No. 2, it will be observed that the suspended matter was reduced by sedimentation from an average of 2,362 parts per million in the raw waste to an average of 344 parts per million in the effluent, or a reduction of 85 per cent. The suspended particles in the effluent consisted of the light fibrous material of the tomatoes, which did not settle out even after prolonged storage. There was a slight reduction of the organic nitrogen and an increase in the ammoniacal nitrogen in the effluent, but the changes in these constituents were not marked.

The average oxygen consumed value for the raw waste was 1,365 parts per million, while the similar figure for the settled waste was 386, which is a reduction of 72 per cent. This removal compares favorably with that of 85 per cent for suspended matter, and indicates that the latter was composed to a large extent of the cellulose fiber of the tomato. This is composed of carbonaceous material which is oxidized by the permanganate in the oxygen consumed test. While the oxygen consuming value of the waste was reduced by 72 per cent in the tank, the oxygen demand results remained practically unchanged by sedimentation. The explanation for these apparent anomalous results is that the tanks removed the suspended matter which is included in the oxygen consumed determination, but does not affect the 10-day oxygen demand to the same extent. Lederer[4] obtained similar results in some studies made at the sewage-testing station operated by the Sanitary District of Chicago. He states in the report that "on the removal of 63 per cent of the total suspended matter the actual impovement in the sewage from the standpoint of prospective nuisance is but 31 per cent." He further reports that "the removal of suspended matter capable of settling in settling tanks constitute an improvement from the dilution standpoint much less than the percentage of suspended matter removed."

It is apparent, therefore, that the oxygen consumed and oxygen demand results obtained from analyzing the influent and effluent of the settling tanks at the cannery testing station followed the same tendency as found by Lederer in tank treatment of domestic sewage. The settleable suspended matter is not readily decomposed by bacterial action, as indicated by the oxygen demand test, but is oxidized by the potassium permanganate in acid solution in the oxygen consumed determination.

Only two determinations were made to show the acidity of the raw waste and effluent from the Imhoff tank. The results of these determinations will be given later on in a separate table under a special discussion of the reactions of the raw waste and effluents from the tanks and various filters.

PRIMARY FILTERS.

Two primary filters, made of washed cinders 4 feet deep with 6 inches of coarse material as underdrainage, were operated throughout the period of the tests. Both received the effluents from the Imhoff tank but at different rates. Filter No. 1 operated at an average net rate of 83,000 gallons per acre per day, while No. 2 treated the waste at an average net rate of 123,000 gallons.

The analyses of the influent and effluent of cinder filter No. 1 are given in the following table:

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[4] The Relation of the Putrescibility of the Settling and Nonsettling Suspended Matter in Sewage. Reprint, American Journal of Public Health, February, 1912.

TABLE No. 3.—*Results of analyses of influent and effluent of cinder filter No. 1.*

[Results in parts per million.]

Date.	Influent (Imhoff tank).							Effluent.								
	Suspended matter.	Nitrogen as—		Oxygen consumed, 30′ at 100° C.	Oxygen demand 20° C.			Rate, thousand gallons per acre daily.	Suspended matter.	Nitrogen as—		Alkalinity by M. O.	Oxygen consumed, 30′ at 100° C.	Oxygen demand 20° C.		
		Organic.	Ammoniacal.		24 hours.	5 days.	10 days.			Organic.	Ammoniacal.			24 hours.	5 days.	10 days.
1916.																
Sept. 8	165	104	....	190	....	....	....	....	150	50	....	940	191			
Sept. 26	300	176	125	335	520	5,120	6,080	91	15	80	47	1,040	170	900	1,890	2,800
Sept. 28	360	144	77	360	....	....	....	....	300	80	68	1,020	210			
Oct. 3	500	210	115	380	660	5,500	5,900	114	230	92	78	1,240	180	900	1,800	2,900
Oct. 5	330	220	140	340	....	....	....	81	230	108	80	1,040	100			
Oct. 13	360	210	110	520	1,330	5,800	6,200	78	15	172	145	1,300	290	640	1,320	1,600
Oct. 17	340	220	130	400	....	....	....	76	160	220	180	1,280	270			
Oct. 19	490	220	130	380	900	5,200	5,800	81	240	180	95	1,140	190	800	1,570	2,200
Oct. 24	210	210	115	320	900	5,300	6,000	76	210	210	150	1,300	190	740	1,440	1,780
Oct. 26	280	220	110	480	....	....	....	76	230	210	110	920	400			
Oct. 30	320	200	125	320	1,600	4,400	5,200	....	155	158	95	1,220	170	450	700	990
Nov. 3	440	208	125	400	1,100	4,200	4,600	....	160	120	65	1,000	160	590	1,000	1,800

This filter removed 46 per cent of the suspended matter applied in the influent and 24 per cent of the total nitrogen in the form of organic and ammoniacal. The oxygen consumed was reduced by 45 per cent while the oxygen demand for 10 days was lowered 69 per cent. These figures are interesting when compared with similar data from the raw waste and effluent from the Imhoff tank. In the latter comparison it has been shown, in the discussion following Table No. 2, that the oxygen consuming power of the raw waste was reduced 72 per cent by tank treatment while the oxygen demand was practically the same after passing through the tank as it was in the raw waste. The explanation for the high removal of oxygen consumed and low removal of oxygen demand by the tank and the reverse for the cinder filter is that the tanks, by removing the settleable suspended matter cut down the highest oxygen consuming power of the waste, while the filter removed the finely divided suspended matter that did not settle in the tanks, and oxidized a part of the organic matter in solution which passed through the tank, thereby reducing the oxygen demand to the large extent already noted.

The removal of the finely divided or colloidal suspended matter by the filters no doubt contributed to the reduction of the oxygen demand by the other filters as well as for No. 1. Lederer, in the reprint already referred to, states that whereas the removal of 63 per cent of settleable solids of sewage effected only 31 per cent improvement of the effluent from the standpoint of putrescibility, the removal of 37 per cent of the nonsettleable suspended solids improved the effluent 143 per cent. This improvement was equivalent to almost five times the results obtained by merely settling the sewage.

The results reported under the heading of "alkalinity" were obtained by titrating samples with N/50 sulphuric acid and using methyl orange as an indicator. Ordinarily the results of this titration are given in terms of calcium carbonate, but in this case they represent lactates which were the end product of the breaking down of citric acid to lactic acid and finally to lactates. On page 44 there will be found a complete discussion of the acidity and alkalinity results found in the tests. It is sufficient at this time to state that there were no weak organic acids present in the effluent from this cinder filter or from No. 2 which operated in parallel with it.

The analyses of the influent and effluent of cinder filter No. 2 are given in the following table:

Table No. 4.—*Results of analyses of influent and effluent of cinder filter No. 2.*

[Results in parts per million.]

Date.	Influent (Imhoff tank).							Effluent.								
	Suspended matter.	Nitrogen as—		Oxygen consumed, 30′ at 100° C.	Oxygen demand 20 ° C.			Rate, thousand gallons per acre daily.	Suspended matter.	Nitrogen as		Alkalinity by M. O.	Oxygen consumed, 30′ at 100° C.	Oxygen demand 20° C.		
		Organic.	Ammoniacal.		24 hours.	5 days.	10 days.			Organic.	Ammoniacal.			24 hours.	5 days.	10 days.
1916.																
Sept. 8	165	104	....	190	....	....	....	....	15	40	....	800	68	....	....	....
Sept. 26	300	176	125	335	520	5, 120	6, 080	139	15	96	73	....	110	220	1, 475	2, 150
Sept. 28	360	144	77	360	....	....	....	....	....	96	73	1, 120	170	....	....	....
Oct. 3	500	210	115	380	660	5, 500	5, 900	142	210	144	95	1, 300	200	330	2, 400	3, 000
Oct. 5	330	220	140	340	....	....	....	134	180	136	115	1, 120	80	....	....	....
Oct. 13	360	210	110	520	1, 330	5, 800	6, 200	106	15	136	75	1, 140	210	860	2, 500	3, 000
Oct. 17	340	220	125	400	....	....	....	114	160	128	105	1, 180	180	....	....	....
Oct. 19	490	220	130	380	900	5, 200	5, 800	116	500	208	65	920	110	370	1, 240	1, 020
Oct. 24	210	210	115	320	900	5, 300	6, 000	106	150	150	105	1, 060	155	440	1, 330	1, 600
Oct. 26	280	220	110	480	....	....	....	123	470	210	115	900	460	....	....	....
Oct. 30	320	200	125	320	1, 600	4, 400	5, 200	....	145	167	110	1, 240	150	760	1, 300	1, 620
Nov. 3	440	208	125	400	1, 100	4, 200	4, 600	....	150	120	60	860	180	900	1, 650	1, 980

The average suspended matter removed by this filter was 46 per cent, which is the same as that for cinder filter No. 1. The removal of total nitrogen was slightly higher than for filter No. 1, and the same was true for the oxygen consumed, which showed a reduction of 53 per cent. The average oxygen demand for all the determinations was reduced by 62 per cent as compared with 69 per cent for filter No. 1. The average values for the alkalinity for the two filters were 1,058 and 1,132 parts per million.

The average results given in Tables Nos. 3 and 4 agree so closely for the various determinations made that it can be safely stated that the preliminary filters removed or oxidized more than 50 per cent of the organic matter in the effluent of the Imhoff tank. This reduction enabled the sand filters to complete the oxidation at practical rates of operation.

SECONDARY FILTERS.

Four sand filters were operated to treat the effluent from the primary or cinder filters. Three of the filters contained 4½ feet of washed Ohio River sand and all, except No. 1, had a layer of coarse and fine stone underdrainage over a sloping concrete bottom. In the latter filter the sand was placed on the concrete without underdrainage, and the depth was 5 feet.

The results showing the analyses of the influent and effluent of sand filter No. 1 are given in the following table:

TABLE No. 5.—*Results of analyses of influent and effluent of sand filter No. 1.*

[Results in parts per million.]

Date.	Influent (cinder filter No. 1).									Effluent.																
		Nitrogen as—				Oxygen demand 20° C.					Nitrogen as—							Putrescibility.		Oxygen demand 20° C.			Bacteria (thousands per c. c.).			
	Suspended matter.	Organic.	Ammoniacal.	Alkalinity by M. O.	Oxygen consumed, 30' at 100° C.	24 hours.	5 days.	10 days.	Rate, gallons per acre per day.	Suspended matter.[1]	Organic.	Ammoniacal.	Nitrites.	Nitrates.	Alkalinity by M. O.	Oxygen consumed, 30' at 100° C.	Dissolved oxygen.	Dilution.	Hours to reduce M. B. at room temperature.	24 hours.	5 days.	10 days.	Gelatin, 48 hours, 20° C.	Agar, 24 hours, 37° C.	B. coli.	Rate, gallons per acre per day.
1916.																										
Sept. 7										Tr.	4		0.00	0.0	400	20								10,000	0.1	
Sept. 8	150	50		840	121					Tr.	4		.00	.0	200	8							330	240	.0	
Sept. 11										Tr.	32		.00	.0	930	54							9,700	1,140	1.0	
Sept. 12										Tr.			.00	.0	900	36	1.9	1:1	18							
Sept. 13										Tr.	16		.00	.0	760	22	1.5	1:1	34							
Sept. 14										Tr.			.27	.0		23	3.2						4,000	4,900	10.0	
Sept. 15										Tr.			.00	.0		24	2.5							900	1.0	
Sept. 18										Tr.			.12	.0	1,200	128	.9	1:1	42							73,300
Sept. 20										Tr.						84	.2	1:1	39					2,000	1.0	102,600
Sept. 22										Tr.			.00			140	.4	1:1	19							108,400
Sept. 26	15	80	47	1,040	170	290	1,825	2,300	90,800	Tr.	59	60	.00	.0	840	100	.8	1:1	19	145	920	1,130				93,800
Sept. 28	300	80	53	1,020	210					Tr.	44	39	.60	.0	1,140	68	4.5	1:3	43	55	240	385				93,800
Oct. 3	230	92	78	1,240	150	250	1,850	2,200	113,800	Tr.	51	45	4.50	1.6	1,060	28	7.2	1:1	42		15	50	570	121	1.0	82,000
Oct. 4																	8.2	1:1	28							199,600
Oct. 5	230	108	80	1,040	100				80,900								4.0	1:1	19							134,800
Oct. 6										Tr.	68	55	5.20	2.0	1,300	60	2.3	1:1	96+	100	660	880	450	1,580	1.0	76,200
Oct. 7																	1.3	1:1	42							101,300
Oct. 11																	4.6	1:1	96+							55,700
Oct. 12																	4.7	1:1	96+							52,700
Oct. 13	15	172	145	1,360	230	640	1,320	1,680	72,600	Tr.	72	53	2.30	23.0	1,080	46	5.8		96+		25	60	360	580	1.0	87,900
Oct. 14																	7.2		96+							79,100
Oct. 16																	9.2		96+							67,400
Oct. 17	160	220	180	1,380	270				75,900	Tr.	92	88	.60	17.0	1,140	40	10.8		96+				56	260	1.0	70,300
Oct. 18																	11.0		96+							76,200
Oct. 19	240	180	95	1,140	180	800	1,570	2,200	80,900	Tr.			4.50	32.0	1,000	80	7.6		96+	8	20	160	95	240	1.0	87,900
Oct. 20																	7.6		96+							87,900
Oct. 21																	10.8		96+							70,300
Oct. 23																	11.0		96+							64,500

Oct. 24	210	210	150	1,380	180	740	1,440	1,780	75,900	Tr.	....	40	4.50	35.0	810	20	6.6	....	96+	......	......	......	69	79	1.0	70,300
Oct. 25	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7.6	....	96+	......	28	132	......	......	....	90,800
Oct. 26	330	210	110	920	480	....	......	......	75,900	Tr.	56	47	2.50	20.0	1,040	40	7.4	....	96+	......	90	124	940	880	1.0	82,000
Oct. 27	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5.4	....	96+	......	......	......	......	......	....	85,000
Oct. 30	155	153	95	1,220	170	450	760	990	77,600	Tr.	37	26	2.30	28.0	1,020	30	5.7	....	240+	......	......	......	3,100	1,550	.1	38,100
Nov. 3	160	120	65	1,000	160	520	1,000	1,200	....	Tr.	35	26	3.00	27.0	940	30	......	....	......	......	......	......	1,350	1,030	.1	78,500

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[1] Tr. indicates less than 15 parts per million.

This filter operated at an average net rate of 86,000 gallons per acre per day treating part of the effluent of cinder filter No. 1. This figure includes, however, the high rates at the beginning of the tests, and is too high an average for the period in which nitrification was active and the reduction of the oxygen demand greatest.

The supended matter of the influent was almost entirely removed by the filter. The trace indicated under the column occasionally amounted to 15 parts per million, when the actual determination was made, but generally was less than 10 parts. The organic and ammoniacal nitrogen of the influent were reduced by approximately one-half, while the oxygen-consuming value of the effluent was only 75 per cent of that in the waste applied to the filters. On days when samples were taken of both the influent and effluent, the 10-day oxygen demand showed an average reduction by this filter of 83 per cent.

Nitrification became established in this filter after about 21 days of operation and the dissolved oxygen and putrescibility improved coincident with the development of nitrates and nitrites. The bacteriological results are not significant except as showing the relative number of bacteria growing on different kinds of media and the approximate total number of *B. coli* in the filtered waste.

Sand filter No. 3 also received a part of the effluent from cinder filter No. 1. The analyses of the influent and effluent of this filter are given in the following table:

TABLE No. 6.—*Results of analyses of influent and effluent of sand filter No. 3.*

[Results in parts per million.]

Date.	Influent (cinder filter No. 1).									Effluent.																
		Nitrogen as—				Oxygen demand 20° C.					Nitrogen as—							Putrescibility.		Oxygen demand 20° C.			Bacteria (thousands per c. c.).			
	Suspended matter.	Organic.	Ammoniacal.	Alkalinity by M. O.	Oxygen consumed, 30′ at 100° C.	24 hours.	5 days.	10 days.	Rate, gallons per acre per day.	Suspended matter.[1]	Organic.	Ammoniacal.	Nitrites.	Nitrates.	Alkalinity by M. O.	Oxygen consumed, 30′ at 100° C.	Dissolved oxygen.	Dilution.	Hours to reduce M. B. at room temperature.	24 hours.	5 days.	10 days.	Gelatin, 48 hours, 20° C.	Agar, 24 hours, 37° C.	B. coli.	Rate, gallons per acre per day.
1916.																										
Sept. 11										Tr.	22		0.00	0.0	1,000	48							6,400	7,600	10.0	
Sept. 12										Tr.			.00	.0	760	18	2.6	1:1	22							
Sept. 13										Tr.	10		.10	.5	560	11	5.3	1:1	43							
Sept. 14										Tr.			.10	.4		12	6.5	1:1	120+				60	60	10.0	
Sept. 15										Tr.			.15	.6		14	5.6	1:1	114					47	.1	
Sept. 20										Tr.			3.00			43	10.0	1:1	120+					4,300	.0	21,100
Sept. 22										Tr.			4.00			20	11.5	1:1	120+							42,200
Sept. 26	15	80	47	1,040	170	290	1,825	2,300	90,800	Tr.	25	18	4.00	.2	1,060	60	8.1	1:1	96+	5.5	200	378				88,600
Sept. 28	300	80	53	1,020	210					Tr.	18	15	2.00	2.0	1,000	46	12.0	1:1	55	2.5	20	76				
Oct. 2										Tr.							12.0						40,700	32,400	10.0	92,800
Oct. 3	230	92	78	1,240	150	250	1,850	2,200	113,800	Tr.	30	19	4.40	1.2	1,040	52	8.2	1:1	42	40.0	800	440				135,000
Oct. 4																	8.2	1:1	26							199,600
Oct. 5	230	108	80	1,040	100				80,900	Tr.	72	42	1.40	.0	1,420	64	5.2	1:1	27	150.0	800	1,260	9,700	7,300	10.0	135,000
Oct. 6																	4.3	1:1	96+							92,800
Oct. 7																	3.8	1:1	42							101,800
Oct. 11																	9.5	1:1	68							97,100
Oct. 12																	8.5	1:1	44							71,700
Oct. 13	15	172	145	1,360	230	640	1,320	1,680	72,600	Tr.	68	53	5.00	3.0	1,180	66	6.5	1:1	96+	60	340	510	7,700	6,000	10.0	84,400
Oct. 14																	8.6	1:1	92							80,200
Oct. 16																	11.4		96+							54,800
Oct. 17	160	220	180	1,380	270				75,900	Tr.	33	28	.60	4.0	1,120	38	11.3		96+				180	850	1.0	67,500
Oct. 18																	8.4		96+							71,700
Oct. 19	240	180	95	1,140	180	800	1,570	2,200	80,900	Tr.	53	38	2.40	22.0	1,040	36	7.8		96+	25	70	80	256	330	1.0	88,600
Oct. 20																	9.0		96+							92,800
Oct. 21																	11.0		96+							97,100
Oct. 24	310	210	150	1,380	180	740	1,440	1,780	75,900	Tr.		26	2.00	44.0	700	14	8.7		96+				67	103	1.0	80,200
Oct. 25																	7.4		96+		5	7				63,300
Oct. 26	330	210	110	920	480				75,900	Tr.	53	40	1.80	9.0	1,240	64	4.8		96+		288	340	1,260	1,290	.1	97,100
Oct. 30	155	153	95	1,220	170	450	760	990	77,600	Tr.	23	14	.70	28.0	940	26	6.3		240+				1,300	1,120	.1	67,500
Nov. 3	160	120	65	1,000	160	520	1,000	1,200		Tr.	68	53	.50	22.0	1,040	22							171	230	.1	85,900

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[1] Tr. indicates less than 15 parts per million.

The average net rate at which this filter was operated was 88,000 gallons per acre per day, which is somewhat more than the average rate of 86,000 gallons for sand filter No. 1.

The slight increase in the rate, however, did not affect the operation of the filter since nitrification actually started earlier than it did in No. 1, and continued active throughout the entire time the tests were run. The dissolved oxygen in the effluent was high, almost from the beginning of the tests, while at times the samples were even supersaturated. The supersaturation was caused by the presence of a blue-green algæ in the distributing troughs and, to a certain extent, on the surface of the sand.

The putrescibility results for this filter were likewise somewhat more satisfactory than for No. 1, although the difference was not what would be expected with the better nitrification and higher dissolved oxygen results obtained during the earlier period of operation.

There was practically no suspended matter in the effluent. The total organic and ammoniacal nitrogen were reduced to about the same extent as was noted for filter No. 1. The material in the influent represented by the oxygen consumed, and the 10-day oxygen demand, were reduced by averages of 75 and 83 per cent, respectively, which figures are exactly the same as for filter No. 1.

The alkalinity results, as already stated, were obtained by titrations with N/50 sulphuric acid using methyl orange as indicator. This determination will be discussed later on in connection with a special table showing the reaction of the waste as it passed through the treatment plant.

The effluent from cinder filter No. 2 was applied to sand filters Nos. 2 and 4. The results obtained from analyses of the influent and effluent of sand filter No. 2 are given in the following table:

TABLE NO. 7.—*Results of analyses of influent and effluent of sand filter No. 2.*

[Results in parts per million.]

Date.	Influent (cinder filter No. 2).									Effluent.																
	Suspended matter.[1]	Nitrogen as—		Alkalinity by M. O.	Oxygen consumed, 30' to 100° C.	Oxygen demand 20° C.			Rate, gallons per acre per day.	Suspended matter.[1]	Nitrogen as—				Alkalinity by M. O.	Oxygen consumed, 30' at 100° C.	Dissolved oxygen.	Putrescibility.		Oxygen demand 20° C.			Bacteria (thousands per c. c.).			Rate, gallons per acre per day.
		Organic.	Ammoniacal.			24 hours.	5 days.	10 days.			Organic.	Ammoniacal.	Nitrites.	Nitrates.				Dilution.	Hours to reduce M. B. at room temperature.	24 hours.	5 days.	10 days.	Gelatin, 48 hours, 20° C.	Agar, 24 hours, 37° C.	B. coli.	
1916.																										
Sept. 7	Tr.									Tr.	3		0.85	0.25	95	8										
Sept. 8	Tr.	46		800	68					Tr.	2		.50	.0	150	7							19	21	0.0	
Sept. 11										Tr.	16		.00	.0	630	32							6,200	7,900	.1	
Sept. 12										Tr.			.00	.0	780	20	3.1		25							
Sept. 13										Tr.	10		.00	.0	610	16	1.7	1:1	35							
Sept. 14										Tr.			.60	.0		17	3.0						4,500	4,300	.0	
Sept. 15										Tr.			.00	.0		69	.0	1:1	17					400	.1	
Sept. 18										Tr.			.60	.0	1,040	102	2.4	1:1	48							102,300
Sept. 20																104	.6	1:1	31							31,300
Sept. 22													.00	.0		84	1.1	1:1	19							49,500
Sept. 26	Tr.	96	73	1,000	110	220	1,475	2,150	138,600	Tr.	61	70	.00	.0	1,320	76	1.2	1:1	19	75	525	900				102,400
Sept. 28	Tr.	96	73	1,120	170					Tr.	52	39	.00	.0	1,240	72	1.9	1:2	43	170	285	943				
Oct. 2										Tr.							3.3									75,900
Oct. 3	210	144	95	1,300	200	330	2,400	3,000	141,900	Tr.	72	58	1.00	1.0	1,200	32	1.0	1:1	24	58	280	460	590	850	1.0	89,100
Oct. 5	180	136	115	1,120	80				133,600	Tr.	76	55	1.70	.75	1,180	60	.7	1:1	19	100	355	510	8,600	10,300	10.0	97,400
Oct. 6																	.0	1:1	96+							94,100
Oct. 7																	.0	1:1	42							107,300
Oct. 11																	16.0	1:1	96+							84,200
Oct. 12																	11.4	1:1	96+							84,200
Oct. 13	15	136	75	1,140	210	860	2,500	3,000	105,600	Tr.	60	53	7.50	7.0	840	39	8.2		67		23	30	110	990	1.0	84,200
Oct. 14																	6.6		48							82,500
Oct. 16																	5.2		92							61,100
Oct. 17	160	128	105	1,180	180				113,500	Tr.	52	38	.40	1.0	1,160	32	8.4		96+				310	1,060	.0	69,300
Oct. 18																	12.1		96+							74,300
Oct. 19	500	208	65	920	110	370	1,240	1,620	115,500	Tr.	44	36	4.00	14.0	860	60	7.5		96+	8	20	20	58	1,040	1.0	95,700
Oct. 20																	4.7		92							77,600

[1] Tr. indicates less than 15 parts per million.

TABLE NO. 7.—*Results of analyses of influent and effluent of sand filter No. 2*—Continued.

Date.	Influent (cinder filter No. 2).									Effluent.																
	Suspended matter.	Nitrogen as—		Alkalinity by M. O.	Oxygen consumed, 30′ at 100° C.	Oxygen demand 20° C.			Rate, gallons per acre per day.	Suspended matter.	Nitrogen as—				Alkalinity by M. O.	Oxygen consumed, 30′ at 100° C.	Dissolved oxygen.	Putrescibility.		Oxygen demand 20° C.			Bacteria (thousands per c. c.).			Rate, gallons per acre per day.
		Organic.	Ammoniacal.			24 hours.	5 days.	10 days.			Organic.	Ammoniacal.	Nitrites.	Nitrates.				Dilution.	Hours to reduce M. B. at room temperature.	24 hours.	5 days.	10 days.	Gelatin, 48 hours, 20° C.	Agar, 24 hours, 37° C.	B. col.	
1916.																										
Oct. 21	....	....	....	......	......	....	......	......	....	......	....	....	......	......	......	......	9.0	....	96+	......	......	......	......	....	....	64,400
Oct. 23	....	....	....	......	......	....	......	......	....	......	....	....	......	......	......	......	10.0	....	96+	......	......	......	......	....	....	38,800
Oct. 24	150	150	105	1,060	155	440	1,330	1,600	105,600	Tr.	....	30	1.70	17.0	940	18	5.0	....	96+	......	......	......	62	65	.0	66,000
Oct. 25	....	....	....	......	......	....	......	......	....	......	....	....	......	......	......	......	3.4	....	68	......	5	16	......	....	....	99,000
Oct. 26	470	210	115	900	460	....	......	......	122,700	Tr.	64	43	.50	4.5	1,180	63	4.2	....	92	......	......	......	5,500	4,600	.1	94,100
Oct. 27	....	....	....	......	......	....	......	......	....	......	....	....	......	......	......	......	2.5	....	72	......	......	......	......	....	....	89,100
Oct. 28	....	....	....	......	......	....	......	......	....	......	....	....	......	......	......	......	2.6	....	67	......	......	......	......	....	....	77,600
Oct. 30	145	167	110	1,240	150	760	1,300	1,620	112,000	Tr.	32	22	2.00	7.0	1,020	34	4.7	....	240+	......	......	......	490	491	.0	69,300
Nov. 3	150	120	60	1,860	180	900	1,650	1,980	111,700	Tr.	35	24	1.50	10.0	1,020	38	......	....	......	......	......	......	318	505	.0	....

The average net rate of this filter was 79,000 gallons per acre per day. The cinder filter which supplied the influent was operated at an average rate of 123,000 gallons. It will be observed by referring to Tables Nos. 5 and 6 that the average rates of treatment on cinder filter No. 1 and the two sand filters Nos. 1 and 3 were, respectively, 83,000, 86,000, and 88,000 gallons per acre per day. Sand filter No. 2 was therefore operated at a lower rate than either sand filters Nos. 1 and 3, but the cinder filter which supplied the influent to sand filter No. 2 was operated at a very much higher rate than the one which supplied sand filters Nos. 1 and 3. This is an important fact to bear in mind in considering the results obtained.

Nitrification did not appear in this filter until October 3, and was not very active until a few days later, while in sand filters Nos. 1 and 3 it developed earlier and was well established in them by the time it started in this filter. The same differences are noted in comparing the dissolved oxygen and putrescibility results. Moreover, throughout the full period of the tests the nitrates, nitrites, and putrescibility results from this filter were inferior to those from the two sand filters operated with cinder filter No. 1. On the other hand the oxygen consumed results were only 1 per cent less satisfactory while the 10-day oxygen demand results were more satisfactory.

In connection with the oxygen demand results attention is called to the very great improvement that took place between October 5 and 13. The analyses of the former date show that the 10-day oxygen demand was 510 parts per million, while at the latter date it had dropped to 30, and continued low thereafter. The increase in the nitrification and the higher dissolved oxygen results obtained during this period also indicate that the filter ripened rapidly after October 5. The more uniform and slightly lower rates on both the primary and secondary filters were also contributory factors.

The suspended matter in the effluent was, as for all the other sand filters, less than 15 parts per million. The total organic and the ammoniacal nitrogen average was less than for the two sand filters already discussed. The alkalinity was about the same as for those filters.

Filter No. 4 was the companion filter of No. 2, in that they both received the same influent.

The results obtained from the analyses of the influent and the effluent from sand filter No. 4 are given in the following table:

Table No. 8.—*Results of analyses of influent and effluent of sand filter No. 4.*

[Results in parts per million.]

Date.	Influent (cinder filter No. 2).									Effluent.																
	Suspended matter.	Nitrogen as—		Alkalinity by M. O.	Oxygen consumed, 30' at 100° C.	Oxygen demand 20° C.			Rate, gallons per acre per day.	Suspended matter.	Nitrogen as—				Alkalinity by M. O.	Oxygen consumed, 30' at 100° C.	Dissolved oxygen.	Putrescibility.		Oxygen demand 20° C.			Bacteria (thousands per c. c.).			Rate, gallons per acre per day.
		Organic.	Ammoniacal.			24 hours.	5 days.	10 days.			Organic.	Ammoniacal.	Nitrites.	Nitrates.				Dilution.	Hours to reduce M. B. at room temperature.	24 hours.	5 days.	10 days.	Gelatin, 48 hours, 20° C.	Agar, 24 hours, 37sC.	B. coli.	
1916.																										
Sept. 11										Tr.	88		0.00	0.0	1,060	102							14,800	23,000	1.0	
Sept. 12										Tr.			.00	.0	820	26	2.7	1:1	22							
Sept. 13										Tr.	10		.00	.0	780	22	3.7	1:1	43							
Sept. 14										Tr.			.17	.35		18	3.8	1:1	120+				800	900	1.0	
Sept. 15										Tr.			.15	.0		39	2.3	1:1	24					360	1.0	
Sept. 18										Tr.			.25		840	13	5.4	1:1	48							80,200
Sept. 19																								6,900	10.0	92,800
Sept. 20										Tr.			.03			20	2.4	1:1	30							
Sept. 22										Tr.			.25			38	4.1	1:1	118							97,100
Sept. 26	Tr.	96	73	1,000	110	220	1,475	2,150	138,600	Tr.	26	22	.60	.0	1,080	24	4.2	1:1	50	48	162	286				101,300
Sept. 28	Tr.	96	73	1,120	170					Tr.	68	52		.0	1,460	64	3.4	1:1	55	63	298	830				
Oct. 2										Tr.							1.9									84,400
Oct. 3	210	144	95	1,300	200	330	2,400	3,000	141,900	Tr.	104	80	.02	.0	1,460	104	1.1	1:1	18	220	1,640	2,720	2,350	1,930	1.0	109,700
Oct. 4																	3.6	1:1	20							88,600
Oct. 5	180	136	115	1,120	80				133,600	Tr.	128	88	.40	.0	1,440	68	2.8	1:1	21	150	980	1,880	4,508	8,600	1.0	101,300
Oct. 6																	2.2	1:1	96+							84,400
Oct. 7																	2.6	1:1	42							71,700
Oct. 11																	11.0	1:1	96+							54,800
Oct. 12																	12.5	1:1	96+							50,600
Oct. 13	15	136	75	1,140	210	860	2,500	3,000	105,600	Tr.	48	42	6.00	7.5	820	26	10.5		96+	5	10	10	88	1,680	1.0	67,500
Oct. 14																	12.1		96+							63,300
Oct. 16																	9.5		96+							80,200
Oct. 17	160	128	105	1,180	180				113,800	Tr.	61	56	.40	2.5	1,140	38	10.0		96+				1,340	1,150	.1	80,200
Oct. 18																	10.9		96+							67,500
Oct. 19	500	208	65	920	110	370	1,240	1,620	115,500	Tr.	51	40	7.00	14.0	1,080	28	11.0		96+		2	20	87	177	.01	59,100
Oct. 20																	10.5		96+							54,900
Oct. 21																	12.1		96+							67,500
Oct. 24	150	150	105	1,060	155	440	1,330	1,600	105,600	Tr.		26	8.50	30.0	790	24	10.2		96+				222	230	.1	63,300

Oct. 25																	12.0		96+		11					46,400
Oct. 26	470	210	115	900	460				122,700	Tr.	30	24	6.00	24.0	960	29	11.0		96+		26	34	310	364	.1	71,700
Oct. 27																	10.3									71,700
Oct. 28																	9.8									63,300
Oct. 30	145	167	110	1,240	150	760	1,300	1,620	112,200	Tr.	22	22	6.00	35.0	840	24	9.9		240+				185	120	.1	54,900
Nov. 3	150	120	60	860	180	900	1,650	1,980	111,700	Tr.	18	16	6.00	44.0	760	24							1,020	1,570	1.0	71,600

[1] Tr. indicates less than 15 parts per million.

This filter was operated at a net average rate of 74,000 gallons per acre per day, which was the lowest rate of any of the sand filters. Filters Nos. 2 and 4 were purposely dosed at lower rates than the other two sand filters, and cinder filter No. 2 at a higher rate than No. 1, in order to determine the efficiency of primary and secondary filters at different rates.

As this filter was operated in parallel with No. 2, the results should agree within reasonable limits. Any difference should be in favor of No. 4, since it was operated at a lower rate.

Nitrification began at about the same time as that found in No. 2, but it continued more actively in No. 4 throughout the tests, and the same general trend toward better results was also found in the dissolved oxygen and putrescibility results.

While individual results for organic and ammoniacal nitrogen, suspended matter, and alkalinity vary somewhat, the averages show that the effluents from sand filters Nos. 2 and 4 contained the above constituents in practically the same amounts.

The oxygen consumed results averaged for those days on which samples were taken from both the influent and effluent show a reduction from 182 to 41 parts per million, or 77 per cent, which is very comparable with a removal of 81 per cent for filter No. 2 and 75 per cent for both filters Nos. 1 and 3.

The reduction in the oxygen demand by this filter was entirely satisfactory as judged by the results obtained after October 5. Between this date and October 13, when the next complete chemical analyses were made, the rate on the filter was reduced, the surface of the bed raked, and the underdrainage flushed out. These changes were sufficient to start active oxidation, which continued till the close of the tests.

The same break in the results noted in the previous paragraph took place in all the other sand filters. This is what would be expected, and attention is called to it for the reason that it showed quite conclusively that the adjustment of rates and other operating conditions must be such that the sand beds will function as oxidizing mediums rather than as strainers. This subject will be considered in detail in the conclusions.

The bacteriological results obtained from the analyses of samples from sand filter No. 4 did not differ materially from those obtained from its companion filter or those from filters Nos. 1 and 3.

ANALYSES OF SUCCESSIVE TREATMENT DEVICES GROUPED TOGETHER.

In the preceding tables the results have been presented to show either the relation of the effluent to the influent or to give all the results obtained from a given source in one table so as to show the variation in the daily results.

It has seemed advisable, however, to collect together in one series of tables all the analyses of raw waste, and effluents of Imhoff tank, cinder, and sand filters when analyses were made of samples collected from each source on the same days.

The arrangement of the table conforms with the order of operation of the various devices. Thus the raw waste is followed by the Imhoff tank, then a cinder filter treating the tank effluent, and finally the sand filters taking the effluent from the cinder filters. The results of these analyses are given in the following table:

TABLE No. 9.—*Chemical analyses of raw waste and effluents from all treatment devices.*

[Results in parts per million.]

Date.	Suspended matter.				Organic nitrogen.				Ammoniacal nitrogen.				Oxygen consumed, 30′ at 100° C.			
	Raw waste.	Imhoff tank.	Cinder filter No. 1.	Sand filter No. 1.[1]	Raw waste.	Imhoff tank.	Cinder filter No. 1.	Sand filter No. 1.	Raw waste.	Imhoff tank.	Cinder filter No. 1.	Sand filter No. 1.	Raw waste.	Imhoff tank.	Cinder filter No. 1.	Sand filter No. 1.
Sept. 26....	690	300	15	Tr.	168	176	80	59	110	125	47	60	380	335	170	100
Sept. 28....	2,880	360	300	Tr.	368	144	80	44	70	77	53	39	2,600	360	210	68
Oct. 3......	6,720	500	230	Tr.	360	210	92	51	110	115	78	45	1,040	380	150	28
Oct. 5......	2,320	330	230	Tr.	360	220	108	68	95	140	80	55	3,440	340	100	....
Oct. 13.....	3,960	360	15	Tr.	360	210	172	72	75	110	145	53	2,550	520	230	46
Oct. 17.....	580	340	160	Tr.	280	220	220	92	105	125	180	88	960	400	270	40
Oct. 24.....	2,200	210	210	Tr.	210	210	210	....	73	115	150	40	420	320	180	20
Oct. 26.....	2,240	280	330	Tr.	210	220	210	56	43	110	110	47	1,160	480	480	40
Oct. 30.....	1,680	320	155	Tr.	208	200	153	37	90	125	95	26	420	320	170	30
Nov. 3.....	350	440	160	Tr.	176	208	120	35	60	125	65	26	680	400	160	30

Date.	Oxygen demand at 20° C. (parts per million).												Sand filter No. 1.					
	Raw waste.			Imhoff tank.			Cinder filter No. 1.			Sand filter No. 1.			Nitrites (parts per million).	Nitrates (parts per million).	Dissolved oxygen (parts per million).	Putrescibility.		Rate, gallons per acre per day.
	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.				Dilution.	Hours to reduce M. B.	
1916.																		
Sept. 26.......	290	....	4,800	520	5,120	6,060	290	1,825	2,300	145	920	1,130	0.0	0.0	0.8	1.1	19	93,800
Oct. 3.........	1,410	7,500	8,550	660	5,500	5,900	250	1,850	2,200	....	15	50	4.5	1.6	7.2	1.1	42	82,000
Oct. 13........	2,600	6,800	8,000	1,330	5,800	6,200	640	1,320	1,680	....	25	60	2.3	23.0	5.8	....	96+	87,900
Oct. 19........	1,550	4,250	5,100	900	5,200	5,800	800	1,570	2,200	8	20	160	4.5	32.0	7.6	....	96+	87,900
Oct. 24.......	850	3,500	4,000	900	5,300	6,000	740	1,440	1,780	....	26	132	4.5	35.0	6.6	....	96+	70,300
Oct. 30.......	1,550	3,800	4,900	1,600	4,700	5,200	450	760	990	....	....	....	2.3	28.0	5.7	....	96+	38,100
Nov. 3.........	1,100	3,470	3,800	1,100	4,200	4,600	520	1,000	1,200	....	....	....	3.0	27.0	....	....	....	78,500

Date.	Suspended matter.				Organic nitrogen.				Ammoniacal nitrogen.				Oxygen consumed, 30′ at 100° C.			
	Raw waste.	Imhoff tank.	Cinder filter No. 2.[1]	Sand filter No. 2.[1]	Raw waste.	Imhoff tank.	Cinder filter No. 2.	Sand filter No. 2.	Raw waste.	Imhoff tank.	Cinder filter No. 2.	Sand filter No. 2.	Raw waste.	Imhoff tank.	Cinder filter No. 2.	Sand filter No. 2.
1916.																
Sept. 26	690	300	Tr.	Tr.	168	176	96	61	110	125	73	70	380	335	110	76
Sept. 28	2,880	360	Tr.	Tr.	368	144	96	52	70	77	78	39	2,600	360	170	72
Oct. 3	6,720	500	210	Tr.	360	210	144	72	110	115	95	58	1,040	380	200	32
Oct. 5	2,320	330	180	Tr.	360	220	136	76	95	140	115	55	3,440	340	80	60
Oct. 13	3,960	360	Tr.	Tr.	360	210	136	60	75	110	75	53	2,550	520	210	39
Oct. 17	580	340	160	Tr.	280	220	128	52	105	125	105	38	960	400	180	32
Oct. 19	....	490	500	Tr.	....	220	208	44	....	130	65	36	....	380	110	60
Oct. 24	2,200	210	150	Tr.	210	210	150	....	73	115	105	30	420	320	155	18
Oct. 26	2,240	280	470	Tr.	210	220	210	64	43	110	115	43	1,160	480	460	63
Oct. 30	1,680	320	145	Tr.	208	200	167	32	90	125	110	22	420	320	150	34
Nov. 3	350	440	150	Tr.	176	208	120	35	60	125	60	24	680	400	180	38

Date.	Oxygen demand at 20° C. (parts per million).												Sand filter No. 2.					
	Raw waste.			Imhoff tank.			Cinder filter No. 2.			Sand filter No. 2.			Nitrites (parts per million).	Nitrates (parts per million).	Dissolved oxygen (parts per million).	Putrescibility.		Rate, gallons per acre per day.
	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.				Dilution.	Hours to reduce M. B.	
1916.																		
Sept. 26	290	....	4,800	520	5,120	6,080	220	1,475	2,150	75	525	900	0.0	0.0	1.2	1 : 1	19	102,300
Oct. 3	1,410	7,500	8,550	660	5,500	5,900	330	2,400	3,000	58	280	460	1.0	1.0	3.3	1 : 1	24	89,100
Oct. 13	2,600	6,800	8,000	1,330	5,800	6,200	860	2,500	3,000	....	23	30	7.5	7.0	8.2	....	67	84,200
Oct. 19	1,550	4,250	5,100	900	5,200	5,800	370	1,240	1,620	8	20	20	4.0	14.0	7.5	....	96+	95,700
Oct. 24	850	3,500	4,000	900	5,300	6,000	440	1,330	1,600	....	....	....	1.7	17.0	5.0	....	96+	66,000
Oct. 30	1,550	3,800	4,900	1,600	4,700	5,200	760	1,300	1,620	....	....	....	2.0	7.0	4.7	....	240+	69,300
Nov. 3	1,100	3,470	3,800	1,100	4,200	4,600	900	1,650	1,980	....	....	....	1.5	10.0	....	....	....	....

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[1] Tr. indicates less than 15 parts per million.

TABLE No. 9.—*Chemical analyses of raw waste and effluents from all treatment devices*—Continued.

[Results in parts per million.]

Date.	Suspended matter.				Organic nitrogen.				Ammoniacal nitrogen.				Oxygen consumed, 30′ at 100° C.			
	Raw waste.	Imhoff tank.	Cinder filter No. 1.	Sand filter No. 3.[1]	Raw waste.	Imhoff tank.	Cinder filter No. 1.	Sand filter No. 3.	Raw waste.	Imhoff tank.	Cinder filter No. 1.	Sand filter No. 3.	Raw waste.	Imhoff tank.	Cinder filter No. 1.	Sand filter No. 3.
1916.																
Sept. 26....	690	300	15	Tr.	168	176	80	25	110	125	47	18	380	335	170	60
Sept. 28....	2,880	360	300	Tr.	368	144	80	18	70	77	53	15	2,600	360	210	46
Oct. 3......	6,720	500	230	Tr.	360	210	92	30	110	115	78	19	1,040	380	150	52
Oct. 5......	2,320	330	230	Tr.	360	220	108	72	95	140	80	42	3,440	340	100	64
Oct 13.....	3,960	360	15	Tr.	360	210	172	68	75	110	145	53	2,550	520	230	66
Oct. 17.....	580	340	160	Tr.	280	220	220	33	105	125	180	28	960	400	270	38
Oct. 24.....	2,200	210	210	Tr.	210	210	210	....	73	115	150	26	420	320	180	14
Oct. 30.....	1,680	320	155	Tr.	208	200	153	23	90	125	95	14	420	320	170	26
Nov. 3.....	350	440	160	Tr.	176	208	120	68	60	125	65	53	680	400	160	22

Date.	Oxygen demand at 20° C. (parts per million).												Sand filter No. 3.					
	Raw waste.			Imhoff tank.			Cinder filter No. 1.			Sand filter No. 3.			Nitrites (parts per million).	Nitrates (parts per million).	Dis-solved oxygen (parts per million).	Putrescibility.		Rate, gallons per acre per day).
	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.				Dilu-tion.	Hours to reduce M. B.	
1916.																		
Sept. 26.......	290	....	4,800	520	5,120	6,080	290	1,825	2,300	5.5	200	378	4.0	0.2	8.1	1:1	96+	88,600
Oct. 3.........	1,410	7,500	8,550	660	5,500	5,900	250	1,850	2,200	40	300	440	4.4	1.2	8.2	1:1	42	135,000
Oct. 13........	2,600	6,800	8,000	1,330	5,800	6,200	640	1,320	1,680	60	340	510	5.0	3.0	6.5	1:1	96+	84,400
Oct. 19........	1,550	4,250	5,100	900	5,200	5,800	800	1,570	2,200	25	70	80	2.4	22.0	7.8	....	96+	88,600
Oct. 24........	850	3,500	4,000	900	5,300	6,000	740	1,440	1,780	....	....	....	2.0	44.0	8.7	....	96+	80,200
Oct. 30........	1,550	3,800	4,900	1,600	4,700	5,200	450	760	990	....	....	....	.7	28.0	6.3	....	240+	67,500
Nov. 3........	1,100	3,470	3,800	1,100	4,200	4,600	520	1,000	1,200	....	....	....	.5	22.0	....	....	....	85,900

Date.	Suspended matter.				Organic nitrogen.				Ammoniacal nitrogen.				Oxygen consumed, 30′ at 100° C.			
	Raw waste.	Imhoff tank.	Cinder filter No. 2.[1]	Sand filter No. 4.[1]	Raw waste.	Imhoff tank.	Cinder filter No. 2.	Sand filter No. 4.	Raw waste.	Imhoff tank.	Cinder filter No. 2.	Sand filter No. 4.	Raw waste.	Imhoff tank.	Cinder filter No. 2.	Sand filter No. 4.
1916.																
Sept. 26....	690	300	Tr.	Tr.	168	176	96	26	110	125	73	22	380	335	110	24
Sept. 28....	2,880	360	Tr.	Tr.	368	144	96	68	70	77	73	52	2,600	360	170	64
Oct. 3......	6,720	500	210	Tr.	360	210	144	104	110	115	95	80	1,040	380	200	104
Oct. 5......	2,320	330	180	Tr.	360	220	136	128	95	140	115	88	3,440	340	80	68
Oct. 13.....	3,960	360	Tr.	Tr.	360	210	136	48	75	110	75	42	2,550	520	210	26
Oct. 17.....	580	340	160	Tr.	280	220	128	61	105	125	105	56	960	400	180	38
Oct. 24.....	2,200	210	150	Tr.	210	210	150	....	73	115	105	26	420	320	155	24
Oct. 26.....	2,240	280	470	Tr.	210	220	210	30	43	110	115	24	1,160	480	460	29
Oct. 30.....	1,680	320	145	Tr.	208	200	167	22	90	125	110	22	420	320	150	24
Nov. 3.....	350	440	150	Tr.	176	208	120	18	60	125	60	16	680	400	180	24

Date.	Oxygen demand at 20° C. (parts per million).												Sand filter No. 4.					
	Raw waste.			Imhoff tank.			Cinder filter No. 2.			Sand filter No. 4.			Nitrites (parts per million).	Nitrates (parts per million).	Dissolved oxygen (parts per million).	Putrescibility.		Rate, gallons per acre per day.
	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.	24 hours.	5 days.	10 days.				Dilution.	Hours to reduce M. B.	
1916.																		
Sept. 26.......	290	....	4,800	520	5,120	6,080	220	1,475	2,150	48	162	286	0.6	0.0	4.2	1:1	50	101,300
Oct. 3.........	1,410	7,500	8,550	660	5,500	5,900	330	2,400	3,000	220	1,640	2,720	.02	.0	1.1	1:1	18	109,700
Oct. 13........	2,600	6,800	8,000	1,350	5,800	6,200	860	2,500	3,000	5	10	10	6.0	7.5	10.5	....	96+	67,500
Oct. 19........	1,550	4,250	5,100	900	5,200	5,800	370	1,240	1,620	....	2	20	7.0	14.0	11.0	....	96+	59,100
Oct. 24........	850	3,500	4,000	900	5,300	6,000	440	1,330	1,600	....	....	....	8.5	30.0	10.2	....	96+	63,300
Oct. 30........	1,550	3,800	4,900	1,600	4,700	5,200	760	1,300	1,620	....	....	....	6.0	35.0	9.9	....	240+	54,900
Nov. 3.........	1,100	3,470	3,800	1,100	4,200	4,600	900	1,650	1,980	....	....	....	6.0	44.0	....	....	....	71,600

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[1] Tr. indicates less than 15 parts per million.

REACTION OF RAW AND TREATED WASTE.

In the discussion of the analytical results of the raw waste and various effluents of the treatment devices references have been made to the reaction of the waste as it was discharged from the cannery and during the different stages of purification. A large number of alkalinity determinations have been reported in the various tables giving the analyses of the cinder and sand filters, but the acidity results for the raw waste and effluent from the Imhoff tank were omitted from the tables owing to the fact that only a few of these results were obtained, and that it seemed advisable to prepare one table containing analyses from all sources and to discuss the results as a whole.

The following tables give the analytical results which show the reaction of the raw waste and effluents:

TABLE NO. 10.—*Results of analyses showing acidity and alkalinity of raw wastes and effluents from various devices.*

[Parts per million.]

Date.	Source of sample.	CO_2 as $CaCO_3$.	Weak organic acids as $CaCO_3$	Alkalinity by M. O
1916.				
Oct. 17	Raw waste	2,300	1,300	....
Do....	Effluent, Imhoff tank	2,050	1,450	....
Do....	Cinder filter No. 1	150	(1)	1,390
Do....	Cinder filter No. 2	100	(1)	1,210
Do....	Sand filter No. 1	110	(1)	1,130
Do....	Sand filter No. 2	80	(1)	1,160
Do....	Sand filter No. 3	50	(1)	1,120
Do....	Sand filter No. 4	50	(1)	1,150
Nov. 2	Raw waste	450	750	....
Do....	Effluent, Imhoff tank	190	1,110	....

[1] Sample neutral to phenophthalein after boiling.

The results given above were obtained in a special study made to determine the most satisfactory indicators to use in titrating acidity and alkalinity of tomato waste before and after treatment, and it is believed they represent the actual conditions that existed throughout the period of the tests.

The free CO_2 was determined by titrating 100 c.c. samples of the waste in the cold with N/50 sodium hydrate, using phenophthalein as an indicator. The weak organic acids were obtained by boiling the samples in which the free CO_2 was determined and titrating the hot sample with N/50 sodium hydrate and phenophthalein.

The results reported as alkalinity do not represent carbonates or bicarbonates as in the case with domestic sewage or some industrial wastes. The citric acid found in the ripe tomato is rapidly decomposed to lactic acid when tomatoes begin to spoil or when tomato waste is stored in tanks. The weak organic acids reported above probably consist mostly of citric acid in the raw wastes and lactic acid in the effluent from the Imhoff tank. In passing through the filters the lactic acid was reduced to lactates and it was these compounds that reacted with N/50 sulphuric acid, using methyl orange as indicator. The effluents from all the filters were practically neutral to phenophthalein after boiling. They gave a slight acid reaction, but it only required a drop or two of N/50 sodium hydrate solution to obtain an end point in a sample of 50 c.c.

Laboratory tests were carried out reproducing, as far as possible, the conditions found in the wastes. Known volumes of citric acid were placed in flasks and after boiling titrated with N/50 sodium hydrate, using phenophthalein as an indicator. The presence of citrates had no effect on the titration or the results obtained. Solutions were next made up containing citrates. These solutions could be titrated with N/50 sulphuric acid using methyl orange, but they were neutral to phenophthalein. Similar results were obtained by using lactic acid and sodium lactate. It is apparent, therefore, that the citric acid of the tomato, through the decomposition of the waste, is converted into citrates and lactates as the waste passes through the tanks and filters. The conditions governing the processes of reduction and oxidation in the tanks and filters were favorable for the production of citrates and lactates rather than some unstable compound which can be formed when the weak organic acids are broken up by bacterial action.

The results obtained from a testing station operated in connection with the treatment of creamery waste gave similar results to those given above. The lactic acid formed from the souring of milk and milk products in the settling tank was converted into lactates, probably sodium, in the sand filters and as such had no effect on the operation of the filters or the stability of the effluents.

VOLUME, COMPOSITION, AND DISPOSAL OF SLUDGE.

On account of the difficulties of measuring and obtaining samples of the sludge in the Imhoff tank, due to the baffling, no measurements or samples were taken from either tank until the testing station was closed down at the end of the canning season. When the baffle in the Imhoff tank was removed the sludge in both tanks was carefully measured and representative samples taken. The results obtained are given in the table below:

TABLE No. 11.—*Volume of sludge accumulated in settling tanks compared with suspended matter removed, and chemical analyses.*

Amount waste treated (gallons)	35,000
Average suspended matter in raw waste (parts per million)	2,547
Average suspended matter in tank effluent (parts per million)	310
Average suspended matter removed by tank (parts per million)	2,237
Suspended matter removed computed as dry solids (tons per million gallons)	9.35
Specific gravity of sludge	1.04
Per cent moisture of sludge	91.1
Volume of sludge measured in tank (cubic feet)	83.8
Dry solids computed from sludge deposited in tanks (tons per million gallons)	6.94
Per cent ash	53.5
Per cent nitrogen	2.0
Per cent calcium as CaO	Trace.
Per cent phosphates as P_2O_5	.95
Per cent potassium as K_2O	.64
Per cent iron as Fe	1.15

The volume of waste that passed through the tanks was 35,000 gallons and the average suspended matter of the raw waste was 2,547 parts per million. The effluent from the Imhoff tank contained an average of 310 parts per million, which indicated a deposit in the tank of 2,237 parts, or 9.35 tons of dry material per million gallons. The amount of sludge measured in the two tanks was 83.8 cubic feet, containing 91.1 per cent moisture and a specific gravity of 1.04. Computing the wet sludge to a dry basis there was found 6.94 tons per million gallons. There was, therefore, a difference of 2.41 tons per million gallons between the amounts found by the two different methods of computation. It is believed that a part of this difference can be attributed to the conversion to soluble form of suspended matter in the tanks, since the fresh pulp in the tomato waste was included in the suspended matter of the raw waste but was more or less dissolved in the souring process in the tanks.

The chemical analyses of the sludge show that it is not of much value as a fertilizer, but when applied to land in generous quantities there is no doubt that the soil would be benefited. It is not believed that the acidity of the wet sludge would have any deleterious effect on soil, since the supernatant waste from the tanks was applied to the same strip of ground several times without affecting the grass and weeds that were growing on it.

As a method of disposing of the fresh solids from tomato canning wastes no other method seems as practical as scattering it on the soil and plowing it in.

When the testing station was closed down all of the sludge in the settling and Imhoff tanks was emptied into two sludge beds 10 feet square and 16 inches deep. The filter contained about 12 inches of screened cinders and 4 inches of sand of the same grade and quality as used in the sand filters for purifying the liquid wastes. The sludge dried down to a spadeable condition in about 10 days and was practically dry at the end of 30 days. When examined closely it was found to consist largely of seeds with some pieces of cores and skins, and other miscellaneous matter which bore no relation to tomatoes. It was practically odorless.

The disposal of sludge from a tomato cannery does not present any serious difficulties, since it has some little value as a fertilizer and there is nothing in its composition to prevent the soil from utilizing the full value of the fertilizing ingredients. Tomato plants may grow where the sludge is applied to the ground, but if it is added in the fall of the year the seeds will sprout and be killed by frost before the time to plant crops the following year.

EFFECT OF THE FILTERED WASTE ON FISH.

On September 18 small concrete basins about 18 inches in diameter and 6 inches deep were constructed to receive the effluents from the sand filters. Two minnows were placed in the basin receiving the effluent from filter No. 1 on September 20, and on the 28th, 18 sunfish obtained from a large goldfish pond near by were distributed in the various basins.

The fish placed in all the basins lived without apparent discomfort up to October 3, except those in the basin receiving the effluent from filter No. 4, which suffered from a lack of oxygen. A small amount of fresh water was added to this basin on the 3d and 4th, and thereafter no further trouble was experienced from this cause. On October 17 all the fish placed in the basins were alive and no fresh water had been added except as noted for No. 4 filter, and except that water was necessarily added regularly to all basins on Sundays as no waste was being discharged from the filters on this day. During the night of October 21 five fish disappeared from the basins. As, however, those remaining were in good condition, it was assumed that those lost had been taken by boys, especially since there were other evidences about the plant to support this conclusion. When the testing station was closed down there were 15 fish in the basins and there were no indications that they had been affected in any way by the filtered waste in which they had lived for 45 days.

The fish test was of considerable importance in connection with the studies made at the Colter Canning Co., since this company had been enjoined from discharging waste into the natural drainage ditch on account of the goldfish ponds located on it. The canning company was contemplating the construction of a treatment plant that would purify the waste, so that it would not affect the goldfish in the ponds which eventually received the waste.

CONCLUSIONS

The testing station operated at the Colter Canning Co. during one tomato canning season had formerly been used in studies on strawboard waste purification and there were sufficient tanks in which to build duplicate primary and four secondary filters. The results obtained from the different filters were so consistent for each step in the treatment that very definite conclusions can be drawn as to the practicability of the processes tested.

RAW WASTE.

The term raw waste has been used in this report to include only the water from washing the tomatoes, the scalding water, and wash water from utensils and canning machinery and from the floors The latter carried only material that fell to the floors together with the normal accumulation of dirt. The raw waste did not contain, therefore, the cores, skins, or any considerable amount of pulp, and this fact should be kept in mind when considering any treatment of tomato waste based on the results given in this report. It is quite obvious that if the pulp, which is commonly referred to as stock for catsup, is discharged as waste the quantity will vary with each cannery and there can be no standard design that will apply to different canneries. At many canneries a large part of the pulp which can not be used in canning tomatoes or for catsup is discharged as waste, but this custom will necessarily have to be discontinued if treatment plants are installed. A small proportion of the excess can be discharged with the other wastes, but in starting a treatment plant all excess pulp should be excluded until oxidation is well established and sufficient data is on hand to decide how much pulp can be safely included without affecting the treatment of the waste on the filters.

There was no evidence obtained in the tests that would indicate that the wastes from the tomatoes affected the pumping equipment, pipe fittings, or galvanized iron that were used in connection with the baffles and piping of the tanks and filters. Since, however, the tests were conducted for only a comparative short period (60 days), it may be advisable to reduce the iron piping as far as practicable and, when pumping is required, to locate the pump outside the pump well.

SEDIMENTATION.

Two tanks operated in series were used as settling tanks in the tests. One was a plain settling tank without baffles and the other was an Imhoff tank with a central baffle which separated the flow section from the sludge digestion chamber. These tanks were available when the tests were planned, and were used in place of one large single tank which would have been installed if new equipment had been purchased. The storage period in the tank varied from a minimum of about 8 hours to a maximum of 48 hours. The variation in the detention period was due to irregular operation of the cannery.

There are two principles involved in considering the design of settling tanks for treating tomato canning waste. The first is concerned with the removal of suspended matter and the second with the souring of the waste. Although definite limits for the length of time waste should remain in tanks to satisfy the two principles referred to above could not be absolutely determined during the tests, there are, however, very good data available upon which to base judgment on the removal of the suspended matter. Experience with other industrial wastes and with domestic sewage has shown that four to six hours is the maximum storage period required to remove practically all the settleable suspended particles.

There is not, however, much data available on the length of time waste should remain in a tank to bring about the bacteriological changes referred to as souring.

In this connection it is to be recalled that canneries do not operate more than 10 hours a day and that there will, therefore, always be a storage period of at least 14 hours for a part of the waste each day. Since the treatment plant will be operated only during warm weather when bacterial action is most active, it is believed that an 8-hour storage during the daytime followed by 14 hours at night will give all the time that will be required for bacterial action in the settling tank. Further tests may reduce this detention period, but until the evidence is obtained it would seem that eight hours should be the minimum provided. If the filters are to be operated 24 hours a day, as recommended at the end of this report, then the capacity of the Imhoff tank will of necessity be large enough to provide storage for more than eight hours, since enough waste must be stored in the tank during the working day to operate the filters when the cannery is closed down.

Of the two settling tanks used in the tests the Imhoff tank gave the most satisfactory results. This opinion was not formed from analytical results, but from observing the operation. The sludge that was first deposited in the bottom of the settling tank later rose to the surface through gas ebullition and formed scum. The scum did not become permanent as is the case with domestic sewage, but had a tendency to break up and settle down again. The suspended matter which made up the scum consisted mostly of small pieces of skins and fibers of the tomato which should be prevented from reaching the surface of the primary filters. If this material should be allowed to flow to the primary filters, there is no doubt their efficiency would be materially lowered. There is also a possibility that a large accumulation of suspended matter of this kind in the upper layer of the cinder filters would give rise to a foul condition which might result in bad odors. Such conditions could not occur with an Imhoff tank in which the sludge is kept separate from the settling waste.

The sludge that accumulated in the settling and Imhoff tanks did not undergo the active decomposition that has been found in domestic sewage, so that the combined superficial gas and scum section of an Imhoff tank for treating tomato waste need not be more than 7 per cent of the total area.

Sludge accumulated in the two settling tanks at a rate of 2.4 cubic feet per 1,000 gallons of waste or per 2,000 No. 3 cans packed. The basis for this statement is contained in the following data:

Total amount of sludge accumulated	cubic feet..	83.3
Volume of waste treated	gallons..	35,000
Volume of waste per No. 3 can packed	gallon..	0.5

The per cent moisture of the sludge was 91.1 and the specific gravity 1.04. On the basis of the figures given above it will be necessary to provide 2.4 cubic feet of sludge capacity in the Imhoff tanks for every 2,000 No. 3 cans of tomatoes packed if the tank is not to be cleaned out during the canning season. It is believed that it will be found more satisfactory to design the Imhoff tank with sufficient sludge capacity to store all the sludge for one canning season. This will simplify the operation of the treatment plant and will allow all the sludge to be dried and disposed of at one time.

The outlet pipe from the Imhoff tank was located 2 feet below the inlet to the settling tank so that the filters could be operated when the cannery was closed down at night or when no tomatoes were being canned. It is believed that a larger volume of waste can be treated on a given unit area of filters and better results obtained if the waste is applied continuously throughout the 24 hours at a low rate, rather than at a higher rate during the working day. The reason for this is that the filters can oxidize a certain amount of organic matter if it is applied continuously in small quantities, but can not oxidize the same total amount if added to the beds in large amounts over a short period of time. It is a question of applying the waste to the filters at such a rate that the time of flow through the beds will be sufficient to permit the bacteria to transform the unstable organic matter to a stable form.

To meet the requirements stated in the previous paragraph it will be necessary to design the flow section of the Imhoff tank to hold the entire volume of waste discharge from a cannery in one day, less the amount applied to the filters during the hours the cannery operates. The outlet from the tank should be located so that the waste can be stored in the tank during the day time and be drawn out during the night. A constant level float valve should be placed on the outlet pipe to give a uniform rate on the filters.

PRIMARY FILTERS.

Two cinder filters each 4½ feet deep were operated throughout the period of the tests. Both the cinder filters were constructed alike in every respect and each received waste from the Imhoff tank, but they were operated at different rates of treatment. Cinder filter No. 1 treated the settled waste at an average net rate of 83,000 gallons per acre per day, while No. 2 was operated at a net rate of 123,000 gallons. These figures, however, included daily rates in the early part of the tests that were too high, so that it is not recommended that the average for all the results obtained be used in designing a treatment plant. It is advisable also to make some allowances for the supervision it was possible to give the filters in the tests which can not be given in treatment plants.

Allowing for the higher rates at the beginning of the tests and giving consideration to the fact that canneries can not be expected to operate treatment plants as carefully as the testing units were operated, it is believed that a reasonable rate to establish for primary filters made of washed or screened cinders is 75,000 gallons per acre per day. If there is reason to believe any given waste is more dilute or more concentrated than that treated in the test, rates higher or lower, respectively, than the one suggested above can be used in computing the area of primary filters required. Unless the waste is very dilute, however, it is not believed that rates higher than 100,000 gallons per acre per day should be adopted for cinder filters until further data is obtained from the operation of full size treatment plants by canning companies.

Automatic siphons were not used in the tests owing to the small amount of waste applied to the filters, but in large installations siphons will be necessary to distribute the waste over the surface of the beds.

SECONDARY FILTERS.

Four sand filters were operated throughout the period of the tests and the results obtained were so nearly alike on the whole that definite conclusions can be stated regarding the efficiency of sand filters in treating the effluent from primary filters such as have been described. The high quality of the results likewise warrant recommendations for the design of sand filters which can be expected to purify the waste so that the final effluent will be stable and not give rise to nuisances in the body of water receiving it.

During the earlier part of the tests the rates on the primary and secondary filters were too high and the final effluents were not satisfactory. After the rates were lowered, however, nitrification developed and the oxygen demand of the sand filter effluents dropped in proportion to the increase of nitrites and nitrates. All the filters reacted so quickly to the changed rates and gave such consistent results afterwards that there can be no doubt that sand filters will produce a satisfactory effluent when treating waste of the character applied to the filters in the test.

All of the filters were contained in round wooden tanks, were composed of the same quality and size of sand, and were alike in construction except No. 1, which had no coarse stone over the bottom for underdrainage. The sand was what was known as washed river sand from the Ohio River. It had an effective size of 0.40 mm. and a uniformity coefficient of 1.35. The depth of sand in all filters was 4½ feet, except No. 1, which had 5 feet, and all, except No. 1, had 6 inches of coarse and fine stone over the bottom.

The conclusions to be drawn from the operation of these filters which are of interest in the design of a large size treatment plant are as follows: First, the ground surface on which the filters are to be located should be smoothed, compacted, and graded so the wastes will drain quickly from the bed when it has passed through the sand; second, farm tile or sewer pipe lines should be laid in trenches under the sand at intervals of not more than 8 feet, with a ridge between each two lines, to give the necessary slope to carry the filtered waste quickly to the drain lines; third, the tile and trenches containing them should be covered with coarse stone, 4 to 6 inches in diameter, and the voids of the large stone filled in with a layer of finer grades, one-half inch to 1 inch, to serve as a bed for the sand; fourth, above the underdrainage there should be 4½ feet of clean sand with an effective size of about 0.40 mm. and a uniformity coefficient of 1.35; fifth, the layer of sand next to the coarse stone of the underdrainage should be carefully placed, so that the sand will not go through the coarse stone to the tile; sixth, the influent should be applied in small, frequent doses rather than in a few large applications; seventh, siphons will be necessary to apply the waste to the sand filters, since effective distribution of the waste over the sand can not be obtained in any other way.

SLUDGE BEDS.

If the fresh sludge is not disposed of by hauling it direct from the tanks to fields it will be necessary to construct special beds for dewatering it. Those used in the tests were composed of a layer of sand 4 inches thick resting on a bed of cinders 12 inches deep with farm tile covered with 6 inches of coarse cinders for underdrainage. This bed was entirely satisfactory, but it is believed that it can be modified so as to reduce the cost without materially affecting the results. Possible changes would involve the omission of the coarse material over the tile and the reduction of depth of the cinders to 8 inches and of the sand to 2 inches. The tile, however, should be laid in trenches and the earth bottom of the bed graded so that the waste filtered from the sludge will flow toward the tile.

The size of the sludge beds will depend on whether sludge is to be drawn from the settling tanks during the canning season or left in them till the close and then all removed at one time. If the latter course is followed and the sludge applied to the filter to a depth of 1 foot, then the area required for each 2,000 No. 3 cans of tomatoes packed will be 2.4 square feet. The depth of 1 foot of sludge on the bed is more than is ordinarily recommended, but is suggested in this case since only one application is to be made and the length of time the sludge is to remain on the bed will not be important.

PLANT RECOMMENDED.

The essential features of a treatment plant for purifying tomato canning wastes are: First, pumping equipment, if there is not sufficient fall between the outlet from the cannery and the receiving body of water to install tanks and filters; second, Imhoff tanks; third, primary filters of screened cinders; fourth, secondary filters made of sand; fifth, siphon and siphon chambers, one for dosing the primary filters and one for the secondary filters; sixth, sludge beds, in case fresh sludge can not be disposed of on land.

PUMPING EQUIPMENT.

The evidence obtained during the tests did not indicate that the waste had any effect on the centrifugal pump that was used for pumping the waste to the settling tanks. It is believed that this type of pump will be the most serviceable for this class of waste, but, as a matter of precaution against clogging, a pump especially designed for handling coarse material should be selected. Until further evidence has been obtained regarding the action of the waste on iron, the pump should not be of the submerged type.

TANKS.

The design of the tanks used in the tests has already been described in the body of the report, and a discussion of the results given in the conclusions. The settling tank did not give satisfactory results, but the Imhoff tank effected a satisfactory removal of the settleable suspended matter, and did not permit the sludge, borne up from the bottom by gas bubbles, to mix with the waste flowing through the tank. The design of the latter tank is shown in figure No. 2, but there are no reasons to believe that any other design of Imhoff tank would not have given equally satisfactory results.

The essential features of design for an Imhoff tank to treat tomato canning waste are as follows:

First, a sludge section to contain 2.4 cubic feet capacity for every 2,000 No. 3 cans of tomatoes packed. This figure is based on the total accumulation for the season. If sludge is removed during the season the size of this section can be reduced.

Second, a flow section equivalent to the maximum volume of waste for one day less the amount treated on filters during the working hours. A storage of eight hours is probably sufficient to remove the suspended matter and develop the maximum bacterial action that will take place, but this storage will not be sufficient to operate the filters at a constant rate for 24 hours.

Third, a gas and scum section equivalent to 7 per cent of the superficial area of the tank.

Fourth, a discharge pipe at the outlet end of the tank with a constant level float valve. This pipe should be located so that the waste in the flow section can be used as influent to primary filters when the cannery is closed down after working hours.

SIPHON AND SIPHON CHAMBER.

An automatic siphon and siphon chamber should be installed to receive the waste from the constant level float valve. The size of the siphon will depend upon the volume of waste, the rate of treatment on the primary and secondary filters, and the size of such filters. Following the principle, already stated, that it is more satisfactory to apply the waste to filters throughout the 24 hours at a low rate rather than at a high rate during the working hours, it will be advisable to install a siphon that will discharge a dose that will just cover the primary filter. It is believed that a siphon which will discharge an amount of waste equivalent to the volume required to cover the bed to a depth of one-half inch is the proper size to install.

PRIMARY FILTERS.

The type of filter referred to under this heading is the cinder filters that were operated in the tests. The design of these filters and the results obtained have been considered earlier in this report. It is now proposed to give a detailed description of the cinder filter which it is believed will give the most satisfactory results, as judged from the data obtained during the tests.

The underdrainage of these filters should be carefully prepared, always keeping in mind that it is essential to have the waste drain quickly from the bed after it has passed through the cinders. The ground surface under the filters should be hard and compact before the farm tile or sewer pipe are laid. The size of the main drainage lines and their location will depend upon the arrangement of the beds, but the laterals should be 4 inches in diameter and spaced not more than 8 feet apart. Between any two parallel laterals the ground should be graded to an even slope of 6 inches to a ridge in the center. The 4-inch lines should be laid on a 5 per cent grade. The trenches in which the laterals are laid should be filled up to the level of the bottom of the main body of the filter with coarse cinders, the larger sizes to be laid next to the tile or sewer pipe.

The filter proper should be 4 feet deep and made of screened cinders that have been screened over a one-fourth-inch screen or thoroughly washed. The purpose of screening or washing is to remove the fine material that will clog the filter if it is allowed to remain in the bed. After the material is ready to be placed in the filter every precaution should be taken in handling it to prevent crushing and the formation of fine material. The cinders should be delivered to the beds in wheelbarrows run on planks laid over the ridges of the bottom or over the material already in the bed. Any other method that will not crush the cinders or break them up so that layers of fine material will result from the washing action of the waste will be satisfactory. Trucks or wagons should not be hauled over the beds.

The filters should be divided into sections of about 20 feet square each, and each lateral feed line to these sections should terminate in the center. Any system of distribution will be satisfactory that applies the waste evenly over the surface of the bed. The troughs used in the tests were satisfactory, but in large installations they should be modified to secure more permanency. A central basin about 2 feet square and 6 inches deep should be provided to receive the influent, and this basin should be supported on the cinders, or preferably on concrete or wooden posts set in the ground under the filter. Shallow troughs 4 inches wide and 2 inches deep with outlet ports spaced 18 inches apart in the side just above the bottom can be used for distributing the waste over the bed. On account of the comparatively large size of material in these filters the waste will enter the cinders at a rapid rate so that it will be necessary to use a rather elaborate system of troughs to get the waste over as large an area as possible. Considering one unit 20 feet square it is believed that radiating troughs should extend from the center toward the corners and the center of each side, the length of the former to be about 10 feet and the latter 5 feet. The outlet ports should be one-half inch square for the first half and 1 inch for the other half of each trough. These troughs can rest on the cinders but far better results will be obtained by supporting the troughs on posts.

The area of primary and secondary filters that will be required will depend upon the volume of waste to treat. The rate of treatment on the filters, however, was established in the tests for tomato-canning waste of the strength discharged from the Colter Canning Co. This rate has been set at 75,000 gallons per acre per day for both types of filters. If wastes from other canneries should be found to be more dilute, the rates on filters treating such wastes can be increased.

SECONDARY FILTERS.

The sand filters operated in the tests have been referred to as secondary filters. The construction of the underdrainage of this type of filter should be similar to that recommended for the primary filters. The ground surface under the sand should be hard and compact before the trenches for the farm tile or sewer pipe are dug. The trenches should be on 8-foot centers and they should have a slope of 6 inches in 4 feet each way from the center to a ridge midway between them. Farm tile, or sewer pipe, laid in the trenches with open joints, can be used under the sand filters or the cinder filters.

The joints, however, should be covered with flat stones or large pieces of cinders to keep the sand from working into the tile or pipe. This tile or pipe should have a gradient of 5 per cent and should not be less than 4 inches in diameter. The main drainage line will depend upon the arrangement of the filters as a whole. Regardless of the volume of waste discharged into the main lines, the size ought not to be less than 6 inches to prevent clogging by sand entering from the beds.

The tile or pipe in the trenches should be surrounded and the trenches filled with 4 to 6 inch stone or cinders and the voids filled with 2 to 4 inch material. The voids in the top layer of stone are then filled with smaller material to keep the sand from working through to the underdrains.

The sand above the underdrainage should be 4½ feet in depth. Washed river or bank sand that has an effective size of approximately 0.40 mm, and a uniformity coefficient of 1.35 and is free of clay, loam, and other foreign material that will tend to clog the bed will be satisfactory for constructing the beds.

Sand of the kind just referred to is a fairly coarse grade. Ordinary washed river or bank sand that is not too coarse or too fine will give good results. The first foot of sand placed over the underdrainage should be shoveled in place in such manner that the sand will not be forced through the coarse stone of the bottom. Above 1 foot the sand can be dumped over the sides of the beds and spread by any means that is practical. Wagons or trucks, however, should not be hauled over the beds.

For purposes of distribution it is believed that the beds should be divided into the same size units as those recommended for the cinder filters; that is, areas of 20 feet square. Siphons should be installed similar to those recommended for primary filters. For each unit one lateral from the main feed line should extend to the center of the bed and be connected with a central basin, 2 feet by 2 feet by 6 inches deep. The basin should be set level, preferably supported on a post, and the pipe enter through the bottom at or near the center. Since the waste will not enter the sand as quickly as it does in cinders and as the flow of waste to each unit will be regulated directly by a siphon and consequently will be flushed over the bed, it will not be necessary to install as many shallow troughs to get the waste away from the center of the bed as will be the case with the cinder filter. For this purpose it is recommended that four troughs 6 inches wide by 2 inches deep be attached to the central basin, with bottoms level, and that they extend out from the basin 5 feet toward the corners of the unit. It will be absolutely necessary to keep the central basin and troughs level if the waste is to be applied over the areas in any uniform volume. Splashboards 18 inches square should be placed under the ends of the trough to prevent holes being washed in the sand.

The waste from the primary filters in the test was applied to the sand filters at an average net rate in excess of 75,000 gallons per acre per day, but it is believed that it will not be advisable to design filters for a higher rate than the one noted above. The reasons for this statement are that the most satisfactory results were obtained at 75,000 gallons per acre, and that the actual operation of large plants can not be controlled as efficiently as were the testing units.

The manner of controlling the waste applied to each small unit will depend upon the arrangement of the bed as a whole. A box with a weir can be placed between the main feed line and the lateral of each unit and the weir adjusted to pass the proper amount to each filter, or a box with a constant float valve can be used. A less accurate method will be to install a gate valve on the lateral to each unit and regulate it to pass the required amount. It is believed there is considerable margin of safety in the amount of waste recommended for treatment on the sand filters, so that the actual amount treated on each unit can vary considerably without materially affecting the results. It should be the plan, however, to apply the wastes to the sand filters as near the rate of 75,000 gallons per acre per day as it is practicable to control it.

SLUDGE BEDS.

Where the tomato cannery is located near land that can be used for disposing of the fresh sludge it may be advisable to haul or pipe the fresh sludge from the settling tanks direct to the land and plow it into the soil. If this can not be done it will be necessary to construct sludge beds.

If the settling tanks are designed to hold all the sludge for one season, the area required for each 2,000 No. 3 cans of tomatoes packed will be 2.4 square feet. This will allow for a depth of 1 foot of sludge on the bed, which is an amount that would not be recommended if the bed were to be used frequently.

The underdrainage should consist of 4-inch farm tile or sewer pipe laid with open joints in trenches about 15 feet apart. The trenches should have a slope of about 4 inches in 7½ feet and should be filled with cinders to a minimum depth of 8 inches, with a layer of sand 2 inches thick on top of the cinders. The drainage from the beds can be pumped into the settling tanks or hauled away and discharged onto land. The quantity will not be large enough to warrant special filters to purify it.

ADAPTABILITY OF PLANT RECOMMENDED TO TREATMENT OF OTHER CANNERY WASTES.

Since there are a large number of canning companies who pack tomatoes in season, but can other vegetables and fruit during the summer, the question will naturally arise as to whether the treatment plant recommended above will purify the waste from other vegetables and fruits. A definite answer can not be given, but it is believed that the waste from tomato canning is as difficult to purify as any that will be produced from any other vegetable or any fruit, and that the treatment plant which will successfully purify tomato waste will give a satisfactory effluent from any canning company, regardless of the vegetables or fruit packed or the length of time the cannery is operated during a season.

RELATED PUBLICATIONS.

Available reprints and bulletins on industrial wastes, issued by the Public Health Service, from which copies may be obtained without cost:

PUBLIC HEALTH BULLETINS.

97. Studies on the treatment and disposal of industrial wastes: I. The treatment and disposal of strawboard waste. By Harry B. Hommon. II. The determination of biochemical oxygen demand of industrial wastes and sewage. By Emery J. Theriault and Harry B. Hommon. 1918. 56 pages; 8 plates.
100. Studies on the treatment and disposal of industrial wastes: III. The purification of tannery wastes. By Harry B. Hommon. 1919. 133 pages.
109. Studies on the treatment and disposal of industrial wastes: IV. The purification of creamery wastes. By Harry B. Hommon. 1921. 87 pages.

REPRINTS FROM THE PUBLIC HEALTH REPORTS.

496. Treatment and disposal of creamery wastes. By Earle B. Phelps. December 6, 1918. 5 pages; 1 plate.
580. Treatment and disposal of sewage. By H. B. Hommon, J. K. Hoskins, H. W. Streeter, R. E. Tarbett, and H. H. Wagenhals. January 16, 1919. 31 pages.
594. A further study of the excess oxygen method for the determination of the biochemical oxygen demand of sewages and industrial wastes. By E. J. Theriault. May 7, 1920. 11 pages. The determination of the biochemical oxygen demand of sewages and industrial wastes. By E. J. Theriault and H. B. Hommon. October, 1918. 16 pages.

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SPECIAL REPORT.

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TRANSACTIONS.

MORNING SESSION, FRIDAY, JUNE 3, 1921.

The Nineteenth Annual Conference of State and Territorial Health Authorities with the United States Public Health Service was called to order at 10 o'clock a. m. June 3, 1921, at room 222, State House, Boston, Mass., Surg. Gen. Hugh S. Cumming presiding.

The following persons were present during the conference:

REPRESENTATIVES OF THE STATE HEALTH DEPARTMENTS.

Alabama: Dr. S. W. Welch.
California: Dr. W. M. Dickie.
Colorado: Dr. Tracy Love and Dr. Hugh F. Lorimer.
Connecticut: Dr. John T. Black.
District of Columbia: Dr. William C. Fowler.
Georgia: Mr. H. C. Woodfall.
Indiana: Dr. J. N. Hurty.
Kansas: Dr. S. J. Crumbine and Mr. Albert Jewell.
Kentucky: Dr. A. T. McCormack and Dr. John G. South.
Louisiana: Dr. Oscar Dowling and Dr. W. H. Seemann.
Maryland: Dr. J. S. Fulton.
Massachusetts: Dr. Eugene R. Kelley and Dr. B. W. Carey.
Michigan: Dr. R. M. Olin, Mr. E. D. Rich, and Mr. William Hearn.
Minnesota: Dr. A. J. Chesley, Mr. H. A. Whittaker, and Dr. H. G. Irvine.
Mississippi: Dr. W. S. Leathers.
Montana: Dr. L. H. Fligman.
Nebraska: Dr. I. H. Dillon.
New Hampshire: Dr. Charles M. Duncan.
New Jersey: Mr. H. P. Croft.
New York: Dr. Matthias Nicoll, jr., and Mr. Theodore Horton.
North Carolina: Dr. W. S. Rankin and Mr. H. E. Miller.
Ohio: Dr. F. G. Boudreau.
Pennsylvania: Mr. C. A. Emerson and Dr. Mary Riggs Noble.

Rhode Island: Dr. B. U. Richards and Mr. Stephen De Gage.

South Carolina: Dr. James A. Hayne, Dr. C. B. Higgins, and Mr. E. L. Filby.

Tennessee: Dr. W. J. Miller.

Vermont: Dr. C. F. Dalton, Dr. W. T. Slayton, Dr. C. W. Kidder, and Dr. F. J. Kidder.

Virginia: Dr. E. G. Williams.

Washington: Dr. Paul A. Turner and Mr. C. E. Dorisy.

West Virginia: Dr. W. T. Henshaw and Mr. E. S. Tisdale.

Wisconsin: Dr. C. A. Harper.

REPRESENTATIVES OF THE UNITED STATES PUBLIC HEALTH SERVICE.

Surg. Gen. Hugh S. Cumming.

Asst. Surgs. Gen. J. W. Kerr, C. C. Pierce, J. W. Schereschewsky, and A. J. McLaughlin.

Directing Zoologist (Reserve) C. W. Stiles.

Surgs. L. L. Lumsden, W. F. Draper, John McMullen, Taliaferro Clark, Paul Preble, R. W. Brown, L. D. Fricks, C. P. Knight, and F. C. Smith.

Surg. (Reserve) J. G. Townsend.

Passed Asst. Surg. (Reserve) J. L. Busby.

Passed Asst. Surg. L. L. Williams, jr.

Statistician E. Sydenstricker.

Associate Sanitary Engineers Sol Pincus, C. H. Harrub, and A. F. Allen.

Asst. Sanitary Engineers A. E. Gorman, I. W. Mendelsohn, and J. I. Connolly.

Junior Asst. Sanitary Engineer E. C. Sullivan.

GUESTS.

Dr. John Amyot, deputy minister of health, Canada.

Dr. Cbacas, Peru.

Dr. John A. Ferrell, International Health Board, New York City.

Dr. D. Z. Dunott, Maryland.

Dr. Lee K. Frankel, third vice president Metropolitan Life Insurance Co., New York City.

Mrs. William Lowell Putnam, Massachusetts.

Dr. Elizabeth Burr Theeburg, Vassar College, Poughkeepsie, N. Y.

Dr. Valeria H. Parker, League of Women Voters.

Dr. Courtenay Dinwiddie, executive secretary National Child Health Council, Washington, D. C.

Dr. Reid Hunt, Massachusetts.

Prof. George C. Whipple, Massachusetts.

Dr. W. C. Woodward, commissioner of health, Boston, Mass.

Dr. R. B. Sprague, Cape Cod health bureau, Yarmouthport, Mass.
Dr. Brigham Snow.
Dr. Leslie Round.
Mr. Thomas R. Crowder, Illinois.

OPENING REMARKS BY THE SURGEON GENERAL.

I take pleasure in opening the Nineteenth Annual Conference of State and Territorial Health Authorities with the United States Public Health Service, and in expressing the thanks of the Federal Government to yourselves and to the State of Massachusetts for the courtesy shown us. I notice with a great deal of interest that they have assigned to us the room which is used by the committee on judiciary. I do not know of any time in the history of this country when we need to assume a judicial atmosphere and to observe good judgment and proper legal processes and reasoning more than at this time, and I hope that it is a good omen. I am not going to make a speech, but I do want to express from the bottom of my heart my sincere appreciation and, I am sure, that of the officers of the service for the hearty cooperation which has been given to the service during the past 12 months by the State health officers of this country. The year has been one of stress both for Federal health officers and for yourselves. In many ways there has been a tendency throughout the world, I think, to criticize and depart from the established governmental methods, for people to think that they can go back to the old Phoenician city idea of direct government action rather than through representative forms of government.

A good many people think that any man occupying office, whether it be city, State, or Federal, must necessarily be bound hand and foot in red tape and inefficiency, and to get quick action some extragovernmental agency must be established. I know that that feeling has extended to most of your States, but I think it is an evidence of temporary post-bellum psychology and that we shall all feel better after a while. We are all suffering, too, Federal and State health officers alike, through the necessity for economy, which is, of course, very real, but which interferes with what we know to be very much needed improvement in our work for the protection of public health. That is something with which we will have to bear for a while. There has been during the year the somewhat unfortunate tendency to bring public health into politics in the city and State as well as in the Federal Government. I hope that will tend to work out for the best. I think a large measure of this is due to the increased interest in public health which is being manifested by the general public, although for the present it has not always been along the lines of efficiency. It may be of interest, because it bears more directly on our relations with you, that there has been a very satisfactory arrangement, and legislation is in process and is practically decided upon by the leaders of the majority in Congress for the relationship of the service with the treatment of ex-service patients. This arrangement I hope will tend to give the service more time and more money to do what we consider direct public health service in cooperation with yourselves. I feel that in this new digression we should take up and study with the light of experience which you have, and your knowledge, some of the Federal legislation proposed. I know of no reason why men whose life work is public health should allow people who have no training in public health and who represent various schools to advise committees in Congress and the public-health profession take no action whatever, giving passive consent to legislation which would necessarily do damage to the public-health cause.

There are various phases of the public health activities which have been taken up during the year which I think had better be considered under the several heads.

I wish to express an apology for not having had this program sent out earlier. In the future we will try to get one out so that you may have time to know what it is proposed to discuss and may have your ideas formulated.

(The secretary, Dr. Schereschewsky, called the roll by States, with the result heretofore noted.)

APPOINTMENT OF COMMITTEES.

The following committee on resolution was appointed by the Surgeon General: Dr. E. G. Williams, Virginia; Dr. C. F. Dalton, Vermont; Dr. R. M. Olin, Michigan; Dr. S. J. Crumbine, Kansas; Dr. W. M. Dickie, California.

Dr. CUMMING. There are certain standing committees which will be continued if it meets with your approval.

REPORTS OF COMMITTEES.

Dr. CUMMING. The next thing is the reports of the standing committees, the first of which is the committee on morbidity returns, Dr. Eugene R. Kelley.

MORBIDITY RETURNS.

Dr. KELLEY. Mr. Chairman and gentlemen, I have an unusual opportunity and privilege at this time—of doing what the chairman of a committee does not frequently get a chance to do—to confess that as chairman of this committee I have done nothing whatever on this work and to call to your attention that another member of the committee, Dr. Fulton, of Maryland, has devoted a great deal of work and time in composing a morbidity report. I therefore suggest that you hear from Dr. Fulton further on this subject.

Dr. FULTON. In about 1914—I do not remember exactly when, but it was before the war broke out—I commenced to observe yearly, and with no great labor, to summarize the experience of the States which at that time had a considerable success in the registration of current morbidity. Now, it would have been a tremendous task to summarize the experience with all the diseases that are on the notifiable lists of the various States, and all one wanted was a reliable index to the measure of effectiveness of registration laws for morbidity, and this was supplied by four diseases. I thought four diseases would satisfy the requirements of such an investigation as I wanted to make. Accordingly, for several years, beginning in 1912, I summarized the four diseases of typhoid fever, scarlet fever, measles, and diphtheria. Those, I think you will agree, furnish very significant numbers for the purpose I then had in mind. I thought at that time that one of the tests, the most advantageous one for the success or the quantitative measurement of the registration of these four diseases, would be the apparent fatality rate. In the deaths from these four diseases one showed more constancy than the other three, and that was typhoid fever. My proposition at the time would have been to make the apparent fatality rate of typhoid fever on a percentage basis the measurement which would determine what was to be considered admissibility to a registration area.

As you know, admissibility to the census mortality area is based on the assumption that it can be determined that your registration is above 90 per cent of that which occurs. I do not myself see how we are going to account for that unknown quantity in a very strictly quantitative sense. At that time one could not include all of the registration of morbidity which the country actually furnished; for instance, there were States where registration of morbidity was on the whole very poor, but the registration in cities was of very considerable magnitude and ought to have been taken into account if one were really going to make a registration area. At that time there were only 21 States included. I could have added from time to time several States, so I can assure you there is no invidiousness in my selection of these States. They happened to be the States that were in the registration area for mortality. This seemed to be enough for what I wanted. Those four diseases have given us a good many more than a million in their total. Now, that is 4 diseases out of some 25 or 30 diseases which are reportable in most of the States considered, and you see that you get a very significant magnitude, as you reflect for a moment that under mortality causes we have 189 with some subdivisions, and considering them all it takes the registration area some time to accumulate a million in mortality. I have gotten by this system more than a million in relatively a few years out of by no means the complete morbidity we could have obtained. Any representative of these 21 States can find out from the charts through inspection and a little counting how his State stands. I do not put out at this time any criterion for the admissibility of States. I do desire, of course, that representatives of all of the States which have morbidity reporting shall look into these figures and find out about how his own State stands.

I feel very confident these 21 can be accepted at the present time as registration States for morbidity. It will not mean anything like perfection, but it will denote a state of progress quite as satisfactory as that with which the mortality officials started out in this country. I am not prepared to discuss the thing in detail, but I will simply call your attention to these several charts, which you can examine at your leisure in order that you may make some criticisms, and I may say that you can criticize the things that are said about your own States. You will find some blank years for some of the States concerned. It has been necessary in some cases to correspond with States, and we find some States incomplete for the reason that at the time this was started some diseases were not notifiable in some States, such as the State of New Jersey, which at the outset did not require the registration of cases of measles. I had recourse to the correspondence between the Public Health Service and the various States for such figures as I could not obtain in the printed reports, and correspondence with secretaries of boards of health relative to items of sickness or morbidity that seemed to be missing in these four diseases. I am very grateful to the secretaries who have been kind enough to answer inquiries along these lines. This material is not at all exhaustive, but it is completely representative and does form a satisfactory basis, and I would like to see this conference, if the Surgeon General approves, do something to start a morbidity registration area. I think it could be done within three or four months, unless congressional action is necessary, and I hope that this is one time that congressional action will not be necessary. I certainly hope it is possible to at least initiate the formation of a registration area for morbidity within the appropriations now available. There has been a considerable amount of work done and it is not necessary to bring it exactly down to date to start. I hope this will commend itself to the State health officers and that at as early a date as possible they will give the Surgeon General the information he will need to carry out this purpose.

Dr. CUMMING. I wish to thank Dr. Fulton for his report, and I may say in passing that for three successive years we have asked an appropriation for this purpose. I hope that we can do something in spite of the lack of it. What is the pleasure of the conference with reference to this report? It is open to discussion and I am sure we would be glad to hear from some of our guests if they should care to discuss it.

Dr. **Leathers.** I should like to ask Dr. Fulton three or four questions in regard to these tabulations. Just what kind of forms were used in obtaining these reports? What was the method of getting reports which were tabulated and the percentage of physicians making reports upon the request from the proper official? Then, what is your opinion in regard to the accuracy of the reports made so far as the diagnosis is concerned, with a view of determining the value of the reports? I ask these three questions for the reason that I want to get your idea on these three points based on your investigation.

It seems to me that the question of morbidity reporting is an exceedingly important one and in our State we have given considerable attention to this. During the past several years we have gone into it carefully with the physicians of the State with a view of obtaining the very best results possible considering the fact that there are a great many difficulties involved. I know of no questions that face the health officers to-day that are fraught with more real difficulty than obtaining accurate morbidity reports. In the first place, I think the medical men of my State are as cordial toward making reports as the medical men of any State but there is an aversion on the part of the medical men relative to making reports, especially in the reporting of venereal diseases and tuberculosis, on clinical cards, and the reporting of acute infectious diseases within 24 hours.

The report which Dr. Fulton made touching upon the great necessity of having a morbidity registration area seems to me a thing of the greatest importance. Gentlemen, I do not belive that the State health officers will ever be able to handle morbidity reporting unless we are assisted by the General Government in some way. As I said yesterday in referring to this particular problem, we have been able to get over 90 per cent of the physicians in Mississippi to make the reports within a certain time, but when you begin to request the physicians to make the report on a card giving certain data that is another and more difficult question, especially if you wish to obtain that report within 24 hours of the diagnosis, which is, of course, essential if you are going to control actute infectious diseases. The physicians are averse to that and they somtimes complain of the lack of time for such reports, which is, of course, ridiculous. At the same time, if we could get Federal support and backing, and arouse pride in the competition between the different States, this rivalry in the making of morbidity reports would bring about good results, just as there has been a rivalry, and you might say pride, in getting into the registration area for births and deaths.

There are a number of points in connection with working out a morbidity area—whether or not it should be done by counties or whether the entire State should be considered as the unit in getting into the morbidity registration area is a matter for consideration. Without going into it very carefully, it seems to me the county might be considered the unit rather than the entire State, because the problem of securing morbidity reports is different from that of securing reports of deaths and births. I can conceive of a very happy rivalry existing between counties in a State in getting reports. In concluding, I think this is the most important problem that is facing us at this time in health work. It is basic in health work to obtain reasonably accurate morbidity reports.

Dr. Dillon. I desire to ask Dr. Fulton, in connection with the questions which Dr. Leathers asked, has he made any effort in his studies to ascertain the percentage of contagious or communicable diseases existing in these States in which there was no physician in attendance? This is a thing that must be taken into consideration when we think of forming a registration area. There are in this country a great many people who are legally qualified to practice the healing art who do not come within the scope of an M. D. There are also many cases of contagious or communicable diseases in which no physician is in attendance, and it is from those cases largely that our epidemics are permitted to spread over the country. The presence of the disease must be reported before we can control it It is a question in many States of law enforcement in getting these reports. Likewise it is a question of law enforcement in getting a report from those cases where no physician is in attendance. Those of you who have attempted to bring a person into court for prosecution know the difficulties you have encountered. I have tried this and got the licking of my life in some instances. I would like to have Dr. Fulton go into this phase of the question a little in closing the discussion.

Dr. Hayne. The only point that I want to bring out is that in getting morbidity statistics the attitude of the physician is that he is perfectly willing to give morbidity statistics, provided he receives something in return. A physician does not care to take his time in making out reports which are used simply for statistical purposes, but if anything is done by the health department to benefit the patient or the physician, he will report his cases. The only disease we have reported in South Carolina is diphtheria, and the reason is because the physician receives treatment for the patient from the State board of health. We have accurate statistics for 10 years on diphtheria in South Carolina, and that is the only disease in which we have accurate statistics. If we could give service to the physician when he reports a disease either to his local board of health or to the county or State, something that would be beneficial to him or to his patient, he would gladly report his cases, and, as I said previously, he is not going to report them to fill up statistical volumes, because, being a physician, he knows the three different kinds of a liar and he is not interested in the last.

Dr. HARPER. When the Surgeon General wrote the health officer of Wisconsin he asked for suggestions of some topic for possible discussion at this conference, and I feel it only right to the Surgeon General and the conference to take up this subject of morbidity reporting because the Surgeon General very kindly, nearly two years ago, detailed a representative of his department to come to Wisconsin and make an intensive study of the morbidity reports. Dr. Olesen, of the Public Health Service, has been untiring in his efforts, and the results obtained, I believe, are worthy of consideration. What I have to say is really a summary of the work done by Dr. Olesen, of the Public Health Service, in our State. We had been running along on the morbidity reports in a general way because we lacked personnel and lacked finances to intensify our activities. In comparing the reports for the last 10 years in Wisconsin with the recommendations of Dr. Fulton in 1914 or 1915 we found that we would not quite come under the line. If I remember correctly the report as published at that time gave about 5.92 deaths per 100 cases reported and we had about 7 over a period of 10 years—7.16 for every 100 cases reported. We started out then with a sort of slogan that "Prompt reports of communicable diseases enable a health officer to set up an effective barrier between the sick and the well." I have written out a good deal, but I will not take the time to read this. We took up the importance of this with those who were really most responsible for making the reports and we classified them as first, the physicians; then the nurses, especially those engaged in public-health work; third, the responsible head of the family; fourthly, the heads of hospitals or other institutions; and then we classified as fifth the local health officers.

I might say that we have 1,741 local health units in Wisconsin and a health officer and a health board in each municipal unit, and the State is also divided into five districts with a full-time deputy State health officer in each district. Some of us from the health department felt that the medical profession needed a little more education in the value of these reports. In the 71 counties of the State we have 43 county or combined county medical societies, so we have visited 21 of these and have given talks to the medical men. We are planning to make the 43 before the close of this year, getting the cooperation of the medical profession. This little trip through the State has given us in the health department something worth while. We have found that the medical men really want to know more of what we are doing than we have been able to explain to them before; and after we spend a couple of hours in going over the program we are asked a lot of questions. We get into pretty warm discussions, and yet the impression left thus far has been very satisfactory and favorable as far as additional morbidity reports are concerned. We write articles for the State Medical Journal. Nearly every medical man is a subscriber to the Wisconsin State Medical Journal. Some of the articles are headed in this manner, " The Evidence of Incomplete Morbidity Registration "; "The Need for Morbidity Registration in Wisconsin"; " Health by Mail." Dr. Olesen gives very instructive and emphatic talks along this line. His subjects include "Study of Communicable Disease Control in Wisconsin"; "A Study of Case Fatality Ratios in Counties in Wisconsin"; "A Study of Case Fatality Ratios in Principal Wisconsin Cities."

The health officers are appointed for a period of two years. Prior to the past two years information has been sent in that so and so has been appointed health officer in a certain district. We have a rural population in Wisconsin where the medical men are not within 25 miles of the center of the health unit, and the health officers in our State are nearly one-half laymen. As soon as a report of an appointment comes in we write and send out a questionnaire asking if they know they are appointed as health officers; whether they have taken the oath of office; whether they have certain material in their possession which they need; and whether or not they are supplied with franked cards. The franking has helped us very materially. We have a collaborating epidemiologist in every community which averages 750 or more population, and then we have two types of cards. When we send out this questionnaire we find that a good many men have heard about being appointed as health officers but do not appreciate the importance of the office, and many of them have not taken the oath of office.

CARD 1.

REPORT OF COMMUNICABLE DISEASE.

Section 1416-1, with amendments (Wisconsin statutes), requires every physician or other person to report to the local health department within 24 hours, in writing, any of the following-named diseases treated, visited, or known to such physician or other person: Chicken pox, cholera (Asiatic), diphtheria, erysipelas, influenza, measles, meningitis (cerebrospinal), ophthalmia neonatorum, plague, poliomyelitis, rubella, scarlet fever, smallpox, trachoma, tuberculosis, typhoid fever, typhus fever, whooping cough, and yellow fever. Chancroid, gonorrhea, and syphilis must be reported on special forms obtainable from the State board of health.

File number ....
Disease (or suspected disease) ....
Date of onset .... Date of first visit .... Date of this report.......
Patient's name ....
Age ...... Sex .... Color .... Married or single? ....
Residence (full and exact) ....
County .... Post office ....

....
(Physician's signature.)

....
(Physician's address.)

CARD 2.

WEEKLY MORBIDITY REPORT.

Report for week ended Saturday *.., 19....

from ...., County of ...., Wisconsin.
(Township, village, or city.)

Disease.	New cases notified	Disease.	New cases notified.
Chicken pox		Scarlet fever	
Diphtheria		Smallpox	
Erysipelas		Trachoma	
Influenza		Tuberculosis	
Measles		Typhoid fever	
Meningitis (cerebrospinal)		Venereal diseases Chancroid	
Ophthalmia neonatorum		Gonorrhea	
Poliomyelitis		Syphilis	
Rubella		Whooping cough	

* Please mail this report Saturday.

If a case of Asiatic cholera, plague, typhus fever, or yellow fever occurs, report it. Mail a card every Saturday. When no cases have been reported during the week, write "No cases reported" on the card and mail as usual.

....
(Signature of health officer.)

If they are not supplied with certain material we immediately see that they are supplied with all the material we are able to supply to local health officials. They are sent report cards, rules and regulations of the State board of health, medical procedure in condensed form. We are distributing placards at a nominal cost, uniform in type, to all health officers for quarantining and placarding. We have two types of report cards, one on the franking system and the other in localities of less than 750 population furnished by the State board of health. We have insisted on this—that every Saturday night the health officer mail a report to the State board of health. Whether there were any cases of communicable diseases reported to him or not, we ask that the report come in just the same, so that on Monday we are able to get quite a large and complete report of the communicable disease situation in the State of Wisconsin. It might be interesting to you to know that while we made no especial effort in years past, yet 10 per cent of our health officers, although

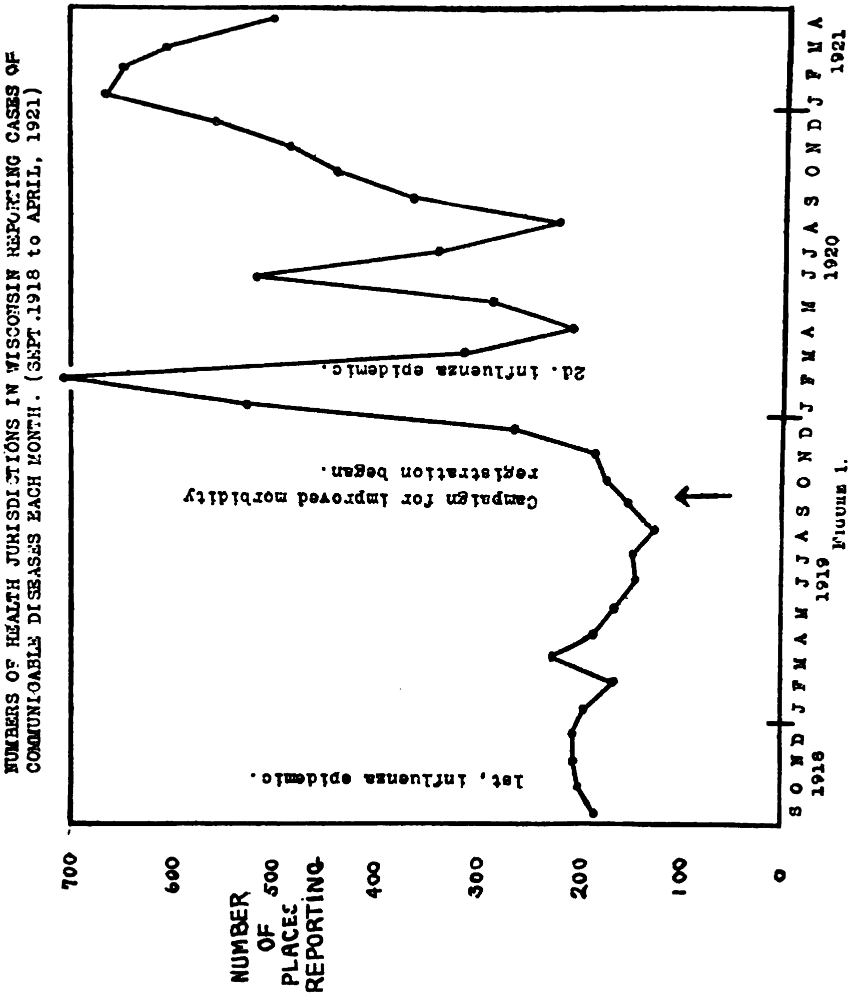
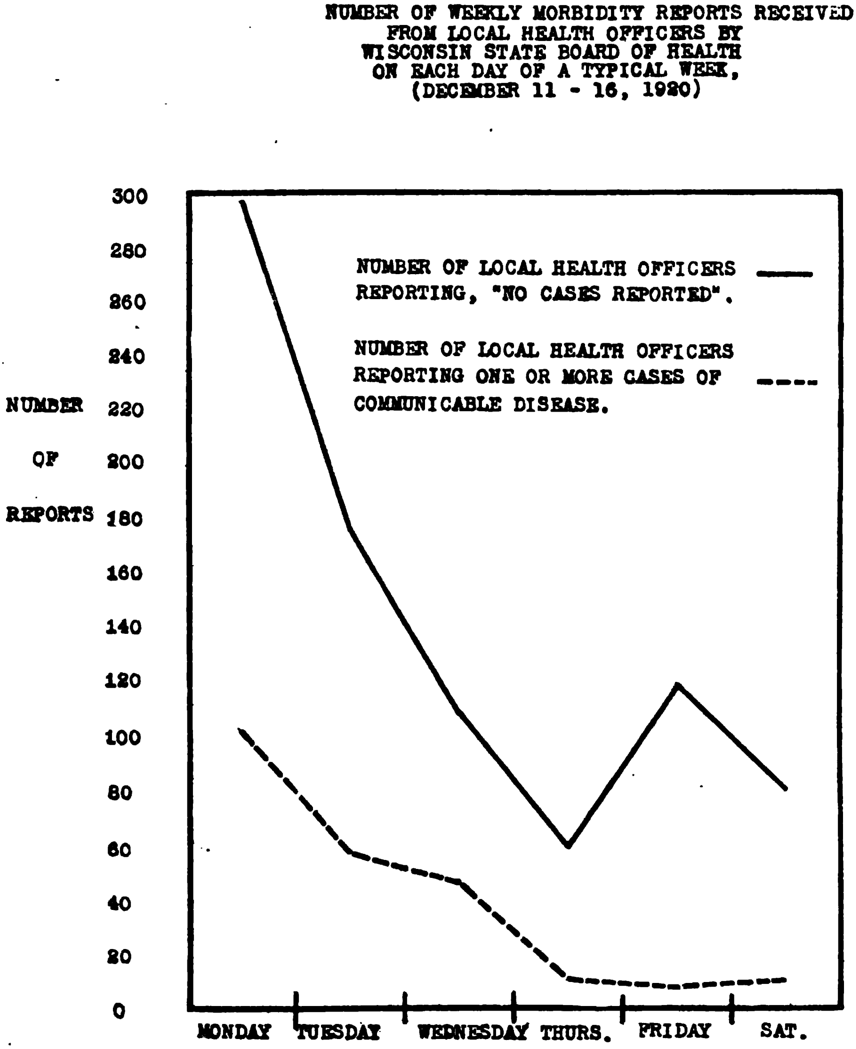


FIGURE 1.

reported to us, were unaware that they had been appointed to the position. Twenty per cent of them had not qualified for the position or taken the oath of office, and we found that about 40 per cent of the entire number of 1,741 local health officers were not supplied with the official rules and regulations and could not reasonably be expected to intelligently enforce the requirements because the outgoing health officer failed to turn over the records and the new man did not know about them. As a result of our work we have had an increase in the morbidity reports in the State.



NUMBER OF WEEKLY MORBIDITY REPORTS RECEIVED FROM LOCAL HEALTH OFFICERS BY WISCONSIN STATE BOARD OF HEALTH ON EACH DAY OF A TYPICAL WEEK, (DECEMBER 11 - 16, 1920)

FIGURE 2.

Here is a chart (fig. 1) showing the number of health jurisdictions in Wisconsin reporting communicable diseases each month from September, 1918, to April, 1921. They range from the beginning in 1918, when we were running on an ordinary scale, about 200 making report of diseases each month, up to 700, the highest peak we had achieved in April, 1921—that is, we have 500 reporting communicable diseases each month over what was the ordinary average at the beginning of the campaign that we put forth. Regarding the reporting on Saturday night—the number reporting cases on Monday was 100; on Tuesday, 59 (and I want to say that it takes a couple of days to reach the central office from some sections in the northern part of the State); on Wednesday, 45; Thursday, 11; Friday, 9: Saturday, 11; showing that the Saturday night habit has really made its impression on the health officer. The total number reporting cases for the week was 235; the total number for the week not reporting cases was 849, making a total number of reports received each week of 1,084, either cases reported or cases not reported. We have here a chart (fig. 2) showing the number of local health officers reporting "No case reports"—that is the dark line, and then the other line gives the number of health officers reporting one or more cases of communicable diseases. Here is the line on Monday, and it drops down to "No case report" and to "Cases reported" on Saturday nearly to a negative quantity.

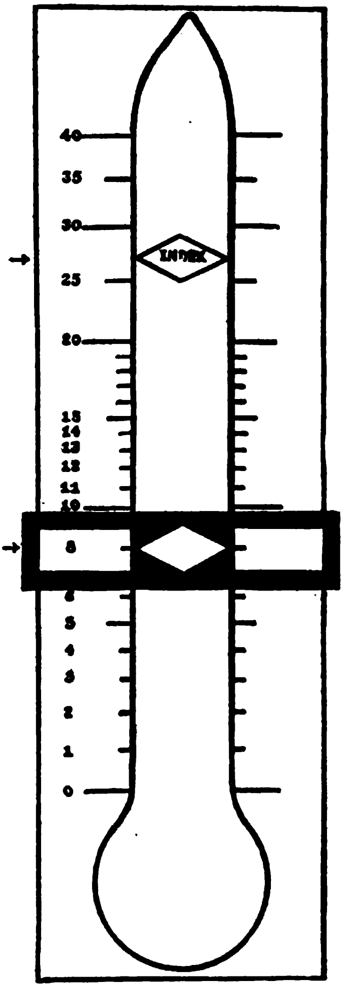


FIGURE 3. "INDICOMETER." (With logarithmic graduations.)

FIXED POINTER. (Median endemic index.)

MOVING INDICATOR. (Showing total number of cases of .... reported during month.)

We keep in the office a thermometer index (fig. 3), and this index is based upon the morbidity reports monthly for a period of five years. We have established a stationary index of what we consider normal for a period of five years of reportable communicable diseases. I want to say right here that while the use is limited to which you can really put a procedure of this character, yet the effect it has upon members of the legislative body is very valuable indeed when they come into the office and see what is being done. We keep moving this index up to see how close we are coming to the normal index. If we go over we know something is wrong. We determine in which locality the increased incidence is occurring, get in touch with that locality, and send assistance there if necessary in order to help control the situation. This is worked out a little like

NUMBER OF CASES OF POLIOMYELITIS
REPORTED ANNUALLY IN THE STATE OF WISCONSIN,
WITH ANNUAL DEATH RATES PER 100,000 POPULATION.

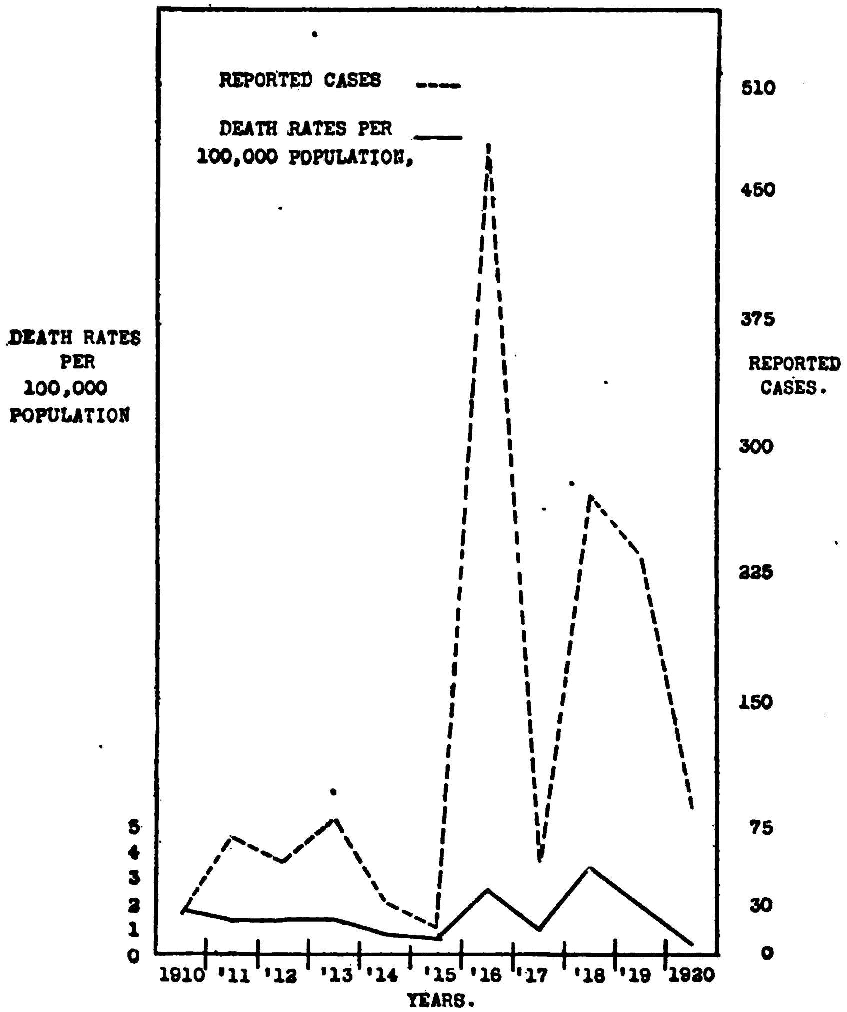


FIGURE 4.

the Massachusetts system developed some years ago, where, I believe, they use the hands of the clock instead of the thermometer as an index in disease. We keep a chart of all the larger cities, but not of the spot-map type. That chart is large and we use our pins to indicate the number of communicable diseases in the city.

I want to show you here (fig. 4) the number of cases of poliomyelitis reported annually in the State of Wisconsin, with annual death rates per 100,000 population. The dark line shows the deaths per 100,000 population. From 1910 over to 1915 we run along with the number of cases reported paralleling pretty well the number of deaths. In 1915 we had an epidemic which aroused the people considerably, so that we went up to 475 cases reported. At that time we had a death rate of 3 per 100,000 population in the State. Up to 1920 we had our little jumps. A peculiar thing might be

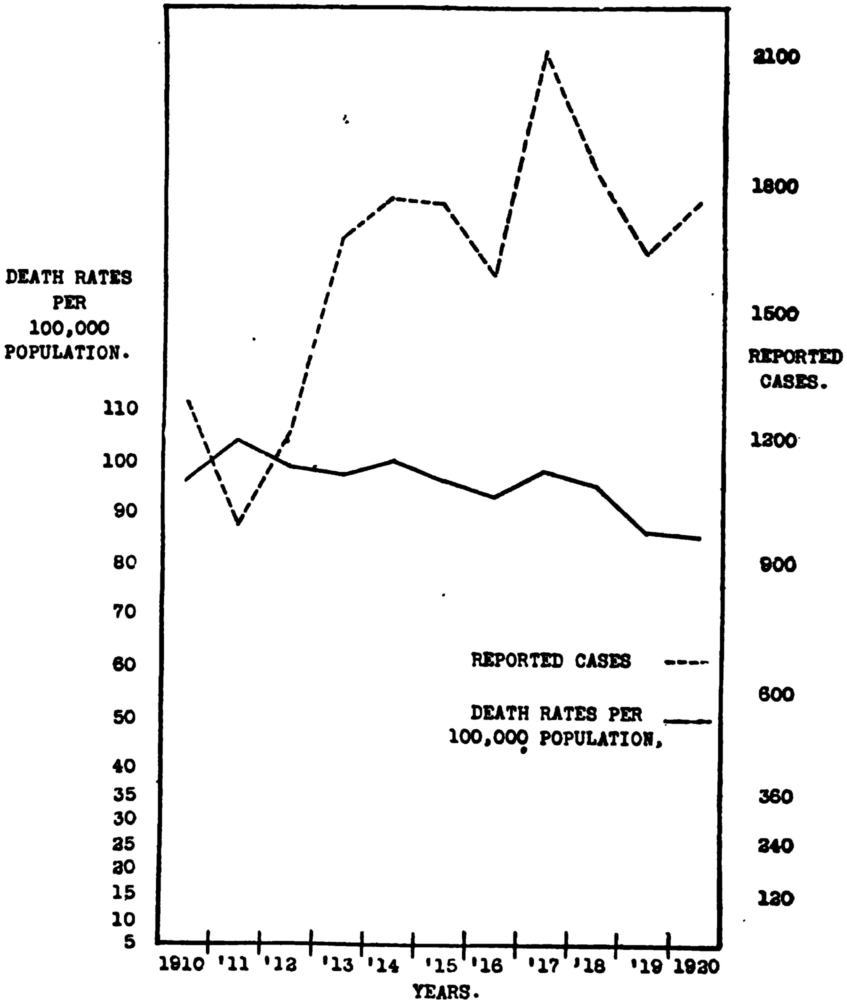

NUMBER OF CASES OF TUBERCULOSIS
REPORTED ANNUALLY IN THE STATE OF WISCONSIN,
WITH ANNUAL DEATH RATES PER 100,000 POPULATION.

FIGURE 5.

noted here. We had a very serious epidemic in the autumn of 1918, starting in the southwestern part of the State, which alarmed us really very materially. For some reason when the influenza struck us we heard nothing more of poliomyelitis, and really it subsided and we have not had much since.

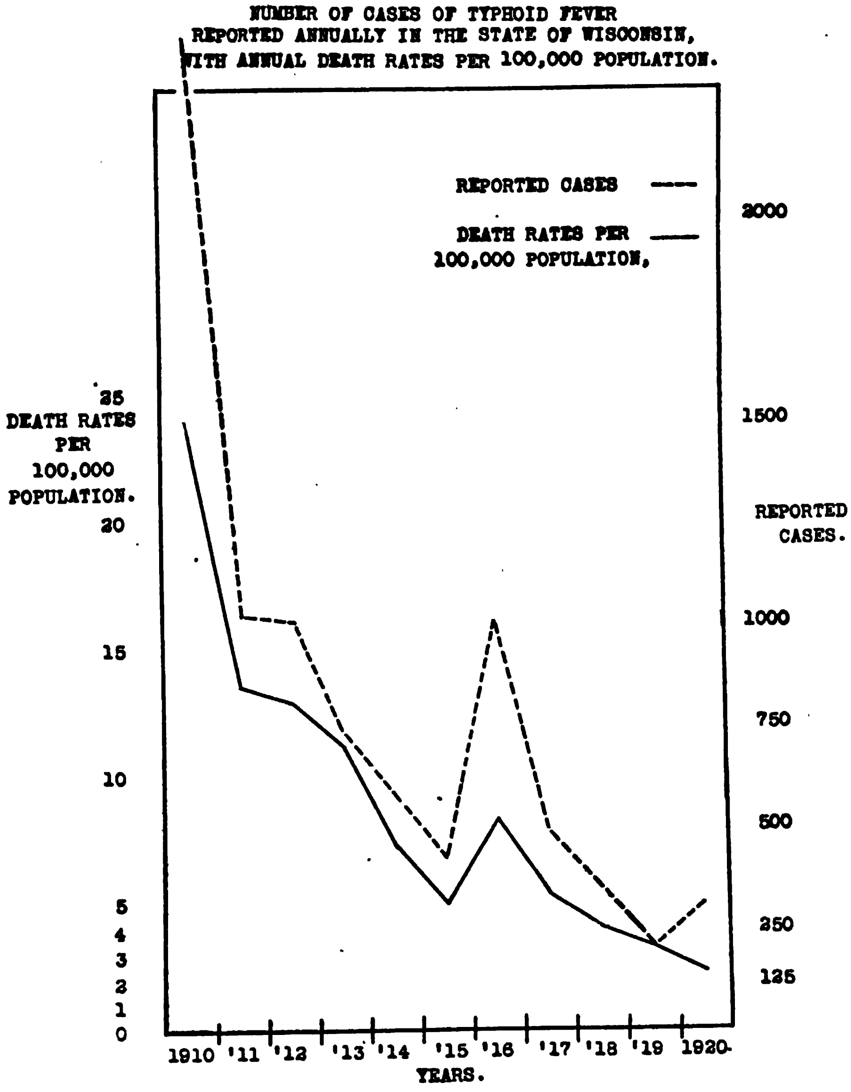


FIGURE 6.

I am simply saying this to show the results of more or less concentrated, intensive activity along the lines of morbidity reports.

The number of cases of tuberculosis reported (fig. 5) are indicated here by the dotted line at the top and the number of deaths per time to accumulate a million in mortality. I have gotten by this system more than a million in relatively a few years out of by no means the complete morbidity we could have obtained. Any representative of these 21 States can find out from the charts through inspection and a little counting how his State stands. I do not put out at this time any criterion for the admissibility of States. I do desire, of course, that representatives of all of the States which have morbidity reporting shall look into these figures and find out about how his own State stands.

I feel very confident these 21 can be accepted at the present time as registration States for morbidity. It will not mean anything like perfection, but it will denote a state of progress quite as satisfactory as that with which the mortality officials started out in this country. I am not prepared to discuss the thing in detail, but I will simply call your attention to these several charts, which you can examine at your leisure in order that you may make some criticisms, and I may say that you can criticize the things that are said about your own States. You will find some blank years for some of the States concerned. It has been necessary in some cases to correspond with States, and we find some States incomplete for the reason that at the time this was started some diseases were not notifiable in some States, such as the State of New Jersey, which at the outset did not require the registration of cases of measles. I had recourse to the correspondence between the Public Health Service and the various States for such figures as I could not obtain in the printed reports, and correspondence with secretaries of boards of health relative to items of sickness or morbidity that seemed to be missing in these four diseases. I am very grateful to the secretaries who have been kind enough to answer inquiries along these lines. This material is not at all exhaustive, but it is completely representative and does form a satisfactory basis, and I would like to see this conference, if the Surgeon General approves, do something to start a morbidity registration area. I think it could be done within three or four months, unless congressional action is necessary, and I hope that this is one time that congressional action will not be necessary. I certainly hope it is possible to at least initiate the formation of a registration area for morbidity within the appropriations now available. There has been a considerable amount of work done and it is not necessary to bring it exactly down to date to start. I hope this will commend itself to the State health officers and that at as early a date as possible they will give the Surgeon General the information he will need to carry out this purpose.

Dr. CUMMING. I wish to thank Dr. Fulton for his report, and I may say in passing that for three successive years we have asked an appropriation for this purpose. I hope that we can do something in spite of the lack of it. What is the pleasure of the conference with reference to this report? It is open to discussion and I am sure we would be glad to hear from some of our guests if they should care to discuss it.

Dr. **Leathers.** I should like to ask Dr. Fulton three or four questions in regard to these tabulations. Just what kind of forms were used in obtaining these reports? What was the method of getting reports which were tabulated and the percentage of physicians making reports upon the request from the proper official? Then, what is your opinion in regard to the accuracy of the reports made so far as the diagnosis is concerned, with a view of determining the value of the reports? I ask these three questions for the reason that I want to get your idea on these three points based on your investigation.

It seems to me that the question of morbidity reporting is an exceedingly important one and in our State we have given considerable attention to this. During the past several years we have gone into it carefully with the physicians of the State with a view of obtaining the very best results possible considering the fact that there are a great many difficulties involved. I know of no questions that face the health officers to-day that are fraught with more real difficulty than obtaining accurate morbidity reports. In the first place, I think the medical men of my State are as cordial toward making reports as the medical men of any State but there is an aversion on the part of the medical men relative to making reports, especially in the reporting of venereal diseases and tuberculosis, on clinical cards, and the reporting of acute infectious diseases within 24 hours.

The report which Dr. Fulton made touching upon the great necessity of having a morbidity registration area seems to me a thing of the greatest importance. Gentlemen, I do not belive that the State health officers will ever be able to handle morbidity reporting unless we are assisted by the General Government in some way. As I said yesterday in referring to this particular problem, we have been able to get over 90 per cent of the physicians in Mississippi to make the reports within a certain time, but when you begin to request the physicians to make the report on a card giving certain data that is another and more difficult question, especially if you wish to obtain that report within 24 hours of the diagnosis, which is, of course, essential if you are going to control actute infectious diseases. The physicians are averse to that and they somtimes complain of the lack of time for such reports. which is, of course, ridiculous. At the same time, if we could get Federal support and backing, and arouse pride in the competition between the different States, this rivalry in the making of morbidity reports would bring about good results, just as there of 25,000 population to have a full-time health officer includes this city, and also we have been able under another law to compel them to put in a chlorinating plant, so that we believe the typhoid situation in that city will be now under control, and if we can eliminate typhoid in that city we can practically eliminate typhoid from the State of Wisconsin as far as original cases are concerned.

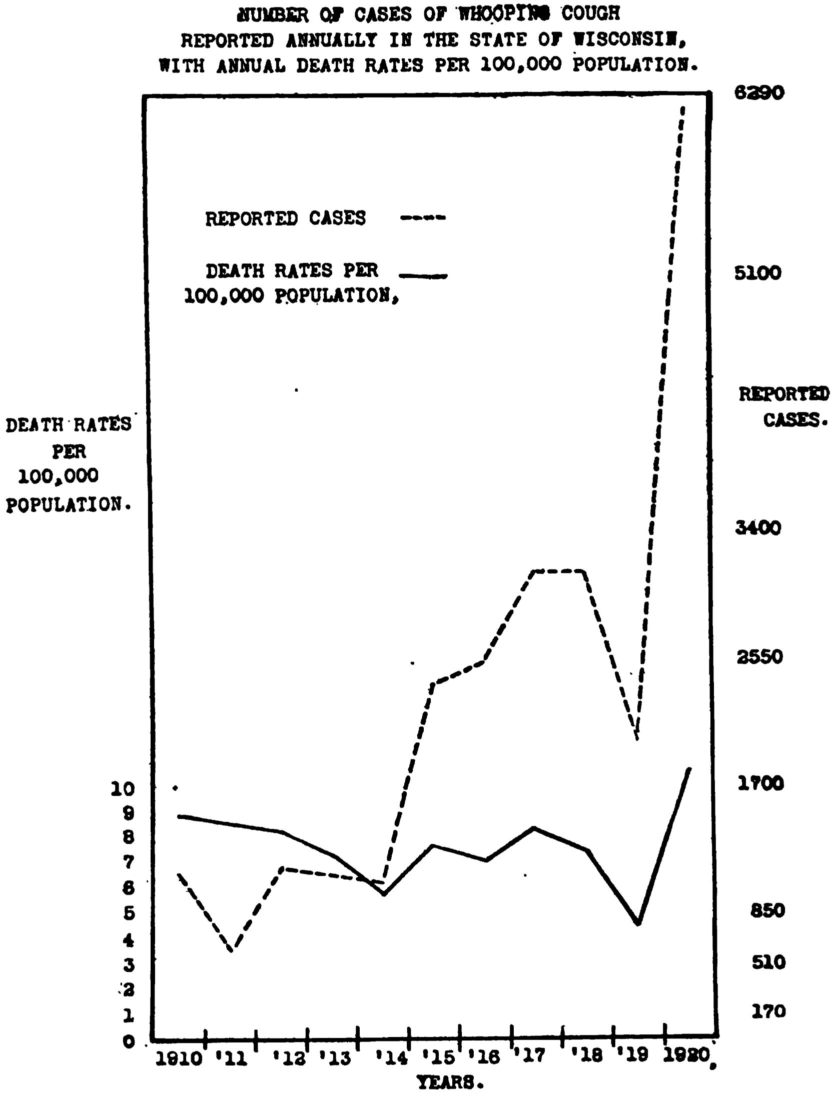

NUMBER OF CASES OF WHOOPING COUGH
REPORTED ANNUALLY IN THE STATE OF WISCONSIN,
WITH ANNUAL DEATH RATES PER 100,000 POPULATION.

FIGURE 9.

Here are the cases of smallpox from 1910 to 1920 (fig. 7). The deaths from smallpox are increasing, stimulating interest toward vaccination. We had 0.1 death, so to speak, for every 100,000 population in 1910. Up in 1920 we had 0.3 death for every 100,000 population from smallpox. After we put into operation our plan of better morbidity reports, while we have 0.3 death per 100,000 population, we have the reports of 1920 running up to 5,400, when our reports in 1913 and 1914 were 3,000, and in 1910 and 1911 were 700 or 800 cases per year, and yet we are not getting all the cases of smallpox reported.

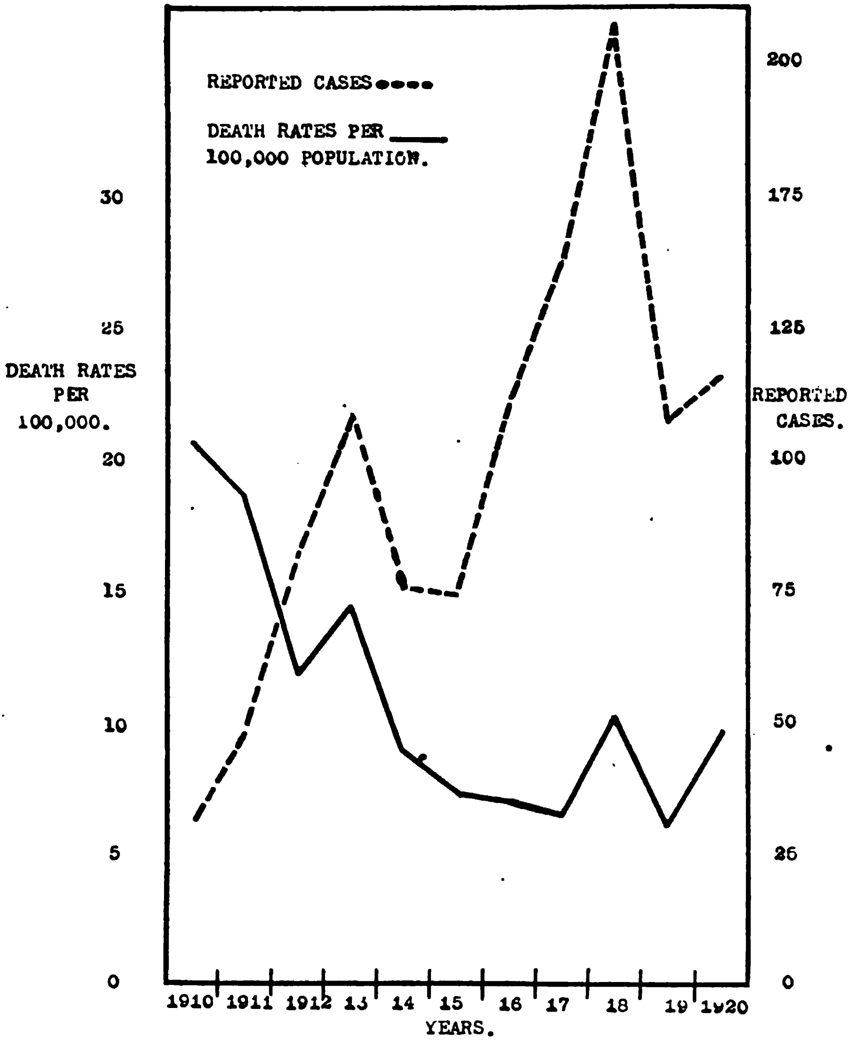

NUMBERS OF CASES OF CEREBRO-SPINAL MENINGITIS REPORTED ANNUALLY IN THE STATE OF WISCONSIN, WITH ANNUAL DEATH RATES PER 100,000 POPULATION.

FIGURE 10.

In diphtheria (fig. 8) we find that we have in 1910 a death rate of 19 per 100,000 population, while we now have a death rate of 14, or 13.5 per 100,000 population. We had cases reported in 1910 up

NUMBER OF CASES OF SCARLET FEVER
REPORTED ANNUALLY IN THE STATE OF WISCONSIN,
WITH ANNUAL DEATH RATES PER 100,000 POPULATION.

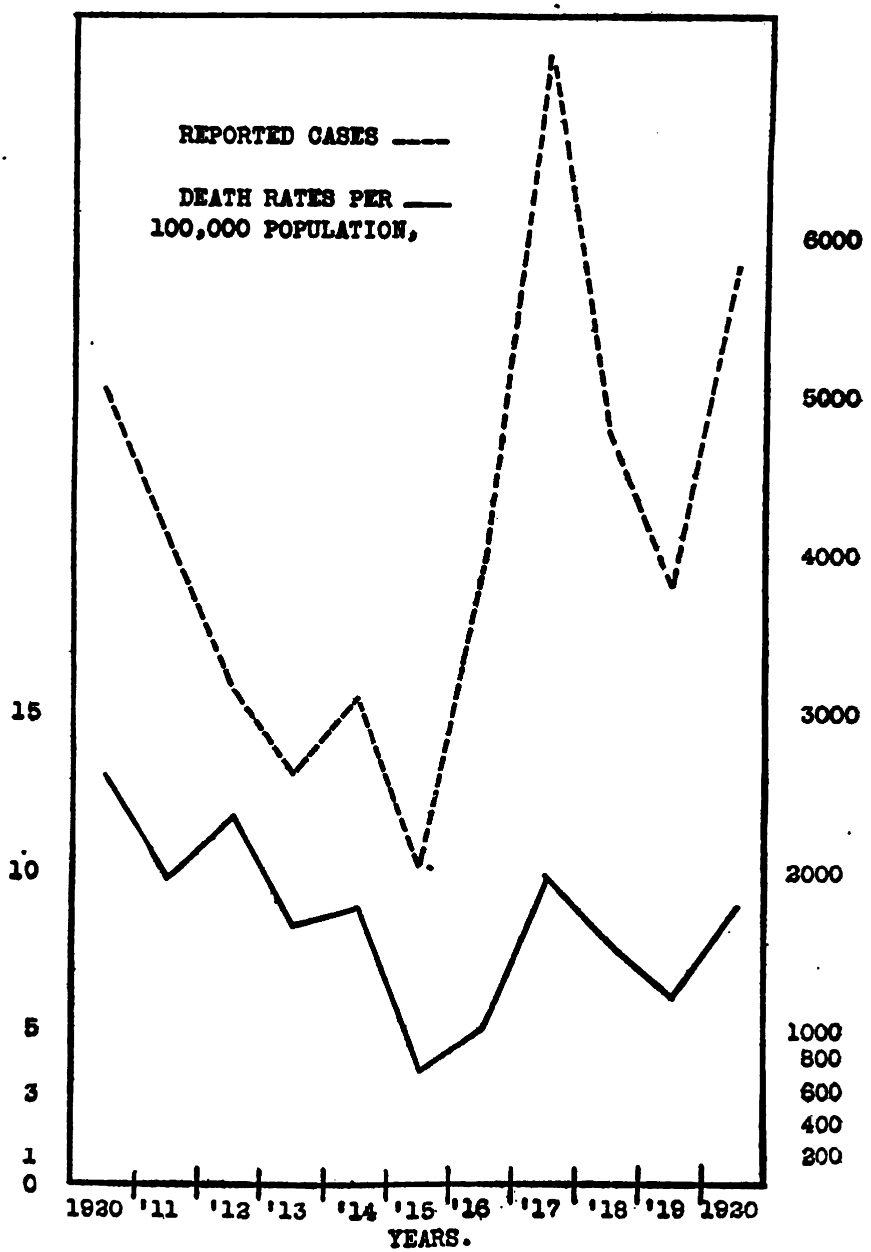


FIGURE 11.

to 1913 and 1914 of about 2,000. Now we have a lower death rate per 100,000 population and we have in 1920, 3,500 cases reported.

The question of whooping cough we find a pretty serious one, and a very difficult disease to have reported. Back in 1910 (fig. 9) we

NUMBER OF CASES OF MEASLES
REPORTED ANNUALLY IN THE STATE OF WISCONSIN,
With ANNUAL DEATH RATES PER 100,000 POPULATION.

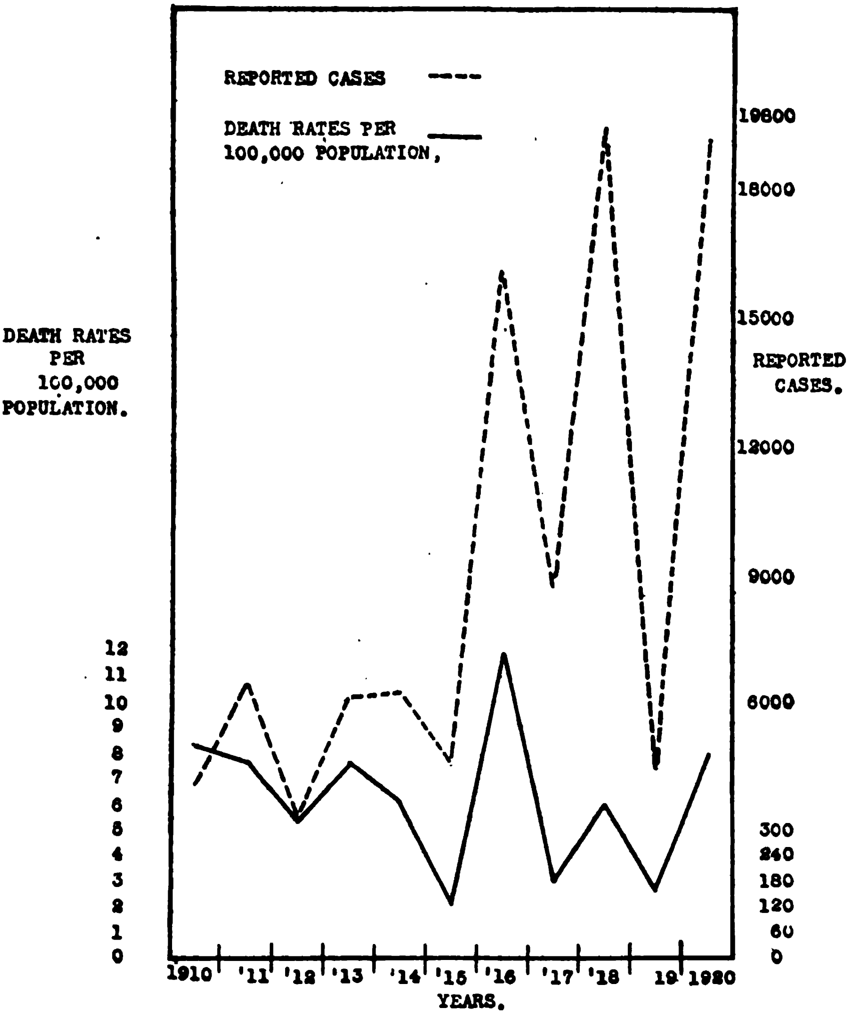


FIGURE 12.

had 875 cases reported, with a death rate of about 6 per 100,000 population. As a result of the campaign you will note that we have increased somewhat. The number of deaths from whooping cough were about 10 per 100,000 and we have had 6,290 cases reported. the

Cerebrospinal meningitis (fig. 10). You will notice the line here as it comes up with better reporting to about 220 cases in 1920 and a death rate of about 9 per 100,000 population, when back in 1910 we had a death rate of about 21 per 100,000 population.

Scarlet fever (fig. 11) is the disease we are having more trouble with, I believe, in Wisconsin than any other disease. We have been lower in our death rate in Wisconsin from communicable diseases than the registration area, but we have been higher on scarlet fever. We have appreciated that. We have done everything we know how within reason to try to reduce the death rate from scarlet fever. In this chart the dotted line shows that we had in 1917 the high peak of about 7,000 cases of scarlet fever reported. In 1917 we had a death rate of 10 per 100,000 population. We have in 1920 nearly 6,000 cases reported and a death rate of about 8 per 100,000 population.

I think that covers pretty generally the situation. Here is measles. (Fig. 12.) The epidemics of measles come rapidly and are severe at times, and the general idea of the lay population is that you are going to have measles sooner or later, and why not have it. Here is the old form of ordinary type of report in 1910. We had just about as many cases as we had deaths from measles. In 1915, however, we had an epidemic of black measles, so called, which got to be quite serious, and we used the publicity columns of the papers warning people that measles was a serious malady, and we began to get better reports. The death rate for measles in 1910 was 8 per 100,000 population, and our death rate got as low at times as 2 per 100,000. That was just prior to the epidemic. Then, in 1920, our death rate came up to 8 per 100,000 population. After the campaign was put on, instead of having 6,000 cases reported we had 19,800 cases of measles reported last year.

I think that is practically all, excepting that while we had 7.12 deaths per 100 cases reported and Dr. Fulton's published report gave 5.95, we can now come in way under the line on that proposition.

We are endeavoring to work with our neighboring States by reporting cases of communicable disease occurring in Wisconsin counties bordering on other States. We hope to do this better than we have in the past. We have been reporting to Iowa, Illinois, Michigan, and Minnesota. We get reports from Minnesota and they get reports from us. We are sending reports to Iowa and Illinois, and across the lake to Michigan, but while we are not hearing from them now, I am very sure we are going to in the future.

I want to emphasize that Dr. Olesen, in charge of this work, has been very painstaking. He has been very patient and I believe his work is not one of temporary benefit but is going to leave permanent results. The medical men want to know and the people generally want to know whether we can really make some use of these reports, and I am sure that we can. We sent out a slogan that "The first case of communicable disease in a community is the serious case," and when we are asked what constitutes an epidemic in a locality we say one case of a communicable disease is really the starting of an epidemic unless it is properly controlled. If we had the extra backing of the United States Public Health Service in having the people held responsible for the reporting of cases of communicable disease I believe that on the main communicable diseases at least we can get as full reports as we had upon mortality and birth reports. It requires great effort, but the results that are apparently manifesting themselves encourage us at least to feel more hopeful.

Dr. Rankin. Before Dr. Harper sits down—he apparently has given a great deal of thought to this, and the whole thing comes down to the question of how to organize a registration area—I would like Dr. Harper to give some constructive suggestions.

Dr. Harper. I do not believe I can answer the question of how to organize. We do not know that we have the proper system nor the best system for obtaining these reports. It is a system we have put into effect, and it has given us really encouraging results. We are establishing a bureau for morbidity reports and holding the head of that bureau responsible for the return of reports. I want to say here that the efforts put forth in the last two years have required the services of one medical man, although he has done a lot of other work in conjunction with this, one clerk, and a stenographer. That is the personnel in the office.

Just how to organize a registration area—I would not want to express a plan of procedure without giving it more thought. We do not know that we are right; that is, we do not know that we have the best procedure, but we have a procedure that is much better than anything we had before and that is giving us results. Back of it all is the necessity of getting the cooperation of the medical profession. I might add a little to that. We have clinics and we have various lines of activities. In certain localities the medical men worked right against us and in other localities they cooperate with us. We sent to certain gentlemen in the medical profession in Wisconsin a letter, which is practically a copy of a letter sent out by Dr. Rankin in North Carolina, which seemed to have had excellent effect on the medical profession of his State. It is a most remarkable letter, right to the point, and the physicians have no comeback.

Dr. Welch. I began reading my report yesterday to the Conference of State and Provincial Health Authorities of North America at 9.30. After some hours, time was called, and I beg leave to finish my report this morning. I have here a tabulated statement of the work on communicable diseases of the States, 37 having reported. I think each of the health officers would be very much interested in this tabulated report and I would like them to take it home with them so that next year they can answer the questionnaire more intelligently. While wandering down through the Old South Church this morning I picked up something that I thought would probably be interesting in an assembly discussing communicable diseases: "Boston, August 13, 1776. This certifies that Ebenezer Simpson has been so smoked and cleansed as that in our opinion he may be permitted to pass into the country without danger of communicating smallpox to anyone. (Signed) John Scully—Nathaniel Atherton, selectmen of Boston."

Dr. LOVE. Just a word in regard to the cooperation of the average physician. Dr. Hayne spoke a few minutes ago about the reward and I think it strikes the nail on the head. What does the average physician get for the time and trouble of reporting these various things? I believe the system we have in Denver is a very good one, namely, each week, throughout the winter at least, a journal is published by the county medical society and in that bulletin our local health officer gives a brief summary of the cases of communicable and contagious diseases which have been reported during that week and the cases which are in progress for the same period. In that way it reminds each man that he has seen such and such a case and he must report it and it stimulates each individual to do that one little thing which is of such interest to us all. If throughout the State each man could receive a weekly or perhaps a monthly announcement of the new cases in progress it would post him as to changes and it would post him to be on the watch for new cases which perhaps are just starting an epidemic in his own city. I think that such a report can be taken care of at very slight expense and would give the men that added stimulus which is so greatly needed in this work of cooperation.

Dr. SCHERESCHEWSKY. Time is passing and I will now ask Dr. Fulton to close the discussion.

The Surgeon General wished me to say that he was called away for a short time and will soon return.

Dr. FULTON. Mr. Chairman, I do not think that the formation of a morbidity registration area needs to await a time when we are perfectly clear as to any more than the fundamental essentials of such an undertaking. I think that they are very simple and that the data here presented are sufficient to give a starting point which will soon bring that about without very much deliberation. The actual obtaining of complete morbidity reports is something of a chimera. One must start with the understanding that the best you can get is the

REV [illegible]

[illegible]

current case that comes to the attention of the physicians. That is all you are going to get by means of the report card and for some diseases that is rather small. I have reflected in my time how embarrassed I would be if I should get all the information available regarding whooping cough. What is available is less than I want. One must not start with the notion that he is going to get complete reporting on account of what we have already brought out many times in the discussion. But the difference between successful and practical reporting is largely the difference between more and most. If there is not a law in the State which makes it mandatory upon the physicians to report at least the main group of infectious diseases I do not think really good progress can be expected. Anybody who goes into the registration of morbidity must do exactly what was done with respect to registration of mortality and births. Those things were slow and painstaking, and so must this necessarily be, and we are dealing with a problem of much greater magnitude. Anybody who goes into this game must be willing to receive a punch and he must have some aptitude or other for delivering a punch. He must know something about the performance and practice of the physicians in his State.

In Maryland at least our experience with the registration of births and deaths gave us long ago one of the means that we apply now in the registration of morbidity—that is to say, every single physician in the State of Maryland has a card in the bureau of vital statistics. He has a card for deaths, births, and communicable disease. He has a record of his performance from year to year. This is not of current use; it is not consulted every day; but the physicians do know that there are pecuniary consequences in case of failure to report infectious diseases. It is an undertaking requiring patience to educate physicians in matters of this sort. Prior to 1907 we did not have in Maryland an effective registration law for the communicable diseases. Our first conviction was a case of smallpox, and some of these major diseases will be the diseases on which you will win your first cases. But in the course of a little while, when you bring them to grand jury proceedings, there is where your first efforts will come. It is even worth while to do a little selective prosecution, and I advise you to keep watch on the most prominent professors in your State. Our case involved such a professor in a university and we have been on the trail of a professor in obstetrics. We are now quite sure he is reporting all of his deaths. We must be patient about these things. I do not feel at all able to recall the many questions that were propounded. What was Dr. Rankin's point? Have I answered it or can I now?

Dr. Rankin. I was going to make a motion, but if you will make it it will save me the trouble. I want this conference to definitely instruct your committee to bring in recommendations for standards of admission to the registration area. I think it is time for action.

Dr. McCormack. I would like to suggest that the committee and the Surgeon General's Office formulate plans and be given the power to act, so that it can be done before the next meeting. It was agreed four years ago that it be done that year. If there is any way we can make the instructions mandatory I would like to make them as mandatory as possible, so that it can be done.

Dr. Crumbine. I would like to call the Chair's attention to the fact that in yesterday's program the committee on resolutions passed a resolution asking the Surgeon General to create a morbidity registration area. That action has been taken.

Dr. Kelley. I would like to report as chairman of the committee that at any time the Public Health Service feels it is ready to start we will do our part. We have not felt it was our business to start it.

Dr. McCormack. It is time it should be done.

Mr. Hayne. I would like to suggest that this model law be limited to not more than 300 words, as it is impossible to get the legislature to pass anything longer.

Dr. Fulton. I should like to call attention to one kind of obstacle that is found in many States to complete morbidity reporting. The big cities are in general in the way of registration of all kinds. When I say big cities, I mean cities which are of sufficient size to consider themselves more than half of a given State. I do not intend to specify any cities, but there are quite a number of cities all over the country which either do not account to the State health officers for their current morbidity or do so in a very imperfect manner and with very considerable delay. I want to say, moreover, there are States in which it is quite clear that the registration of morbidity is considerably better under rural conditions and small town conditions than it is under the conditions of medical practice in the large cities. I think that is because the municipal health officers are more sensitive against legal proceedings—they do not pack a punch and they do not care to receive one. This has no particular application within the walls of this room, but it is a fact. I will take the liberty to state that it is my general impression that the State of Massachusetts itself has at times suffered in that respect and that kind of delinquency may prove to be very embarrassing. I remember a state of affairs when the predecessor to Dr. Kelley had great difficulty in obtaining information from the many towns that there are in Massachusetts. In the State of Maryland at the present time we get reports from the remotest towns and hamlets faster than we do from the city of Baltimore. The situation is improving, however, and the present commissioner of health was formerly in the bureau of communicable diseases in the department. I can see in his new position that he has an entirely new view in regard to the State's responsibility. I am confident that in other States besides Maryland it will be found that the large cities are frequently quite as reluctant as any practicing physician to turn over their information concerning infectious diseases.

Regarding the time of report. Every health officer does not wait until the end of the week—he sends in his report every night. His list must come in within 24 hours. I do not mean we hold him to very stringent account, for the very best you can do will be occasionally broken down as occurred to some extent during the epidemic of "flu." Then the medical profession had no time in the 24 hours to sit down and write out a separate card, yet a very astonishing number was reported and in an extremely short time we had more than 60,000 cases of influenza recorded in the State department of health. We do not propose to think for a moment that was all of the cases that did come to medical attention, but it was a very substantial number. I should never have supposed that any contingency as large as that would ever have occurred in the life of one health officer and it showed that the medical men, notwithstanding the pressure they were under, were able to report and did so, so that not only the good will but the laborious attention of physicians can be gradually won if you are patient and persistent enough and if you do deal summarily with that very small fraction of the medical profession which holds itself above all obligations.

Dr. SCHERESCHEWSKY. What is your pleasure in regard to this report? I may say that the only thing which has held us back from taking some action in this matter has been our inability to impress upon the Appropriation Committee that we ought to have a little money for this purpose. We have asked in the past three years for $100,000 to establish a morbidity registration area but they have been unresponsive. We are all of us agreed that we ought to get this thing going and I believe thoroughly that we should. The thing is for you gentlemen to help us get it.

Dr. McCORMACK. I move that the committee on resolutions be requested to memorialize Congress, calling attention to the necessity of the establishment of such a morbidity registration area so that the people of the country may know the ravages of disease.

(Motion carried.)

Dr. SCHERESCHEWSKY. The resolutions committee is accordingly directed to prepare a resolution memorializing Congress as to the needs of establishing a registration area for morbidity. We will now proceed to the next report, which is that of the committee on sanitation of public conveyances, Dr. Dowling.

Dr. Dowling. We will make this very brief. The report is signed by Dr. Hurty and myself. The other members of the committee were furnished with copies but I have not yet heard from them.

Dr. Dowling read the following report:

SANITATION AND PUBLIC CONVEYANCES.

It is the sense of the committee that the regulations governing the sanitation of public conveyances, adopted at the conference in 1920, are adequate; that no changes or additions are needed.

In view of this fact, the existing conditions, and the attitude of the public in general, the committee recommends:

1. That the State health commissioner of each State institute an educational campaign calling the attention of the public to the efforts of the railroad authorities for transportation sanitation.
2. That the public be urged to give assistance in every way possible to further the plans and efforts of the railroad companies.
3. That the public be requested to note violations of the sanitary law, either State or interstate, on all boats, trains, etc., on which the individual may happen to be, and that these violations be reported to the proper authorities with requests that the law be enforced.
4. That in every State which has not adopted the regulations approved by this conference the State executive be asked to use his influence for the enactment of the regulations into a State law.

Dr. Schereschewsky. What is your pleasure regarding this report?

Dr. Kelley. It seems to me that we should not dispose of this report at once without a little discussion. The opening sentence of the chairman, which was perfectly natural under the circumstances, his report having been written for several days and not taking into consideration the proceedings of yesterday's meeting, is "no change should be made over the draft adopted a year ago." The Association of Railway Surgeons sent in a special delegate to the conference yesterday who put up what most of us thought was a fairly reasonable request that these regulations should be modified very definitely on the point of excluding sanitation of the right of way, that is, permanent fixtures attached to the soil, from the regulations which were designed originally to affect rolling stock engaged in interstate commerce. After rather acrimonious discussion two States of the Union decided once more to secede. Kentucky and Michigan decided not to join. The rest of us thought the request was sufficiently reasonable so that so far as I know all the other States represented voted to adopt this proposed change. I did hope that for once we might put over something that is unanimous at one of these conferences. I would suggest that the matter be once more explained as it was so ably yesterday by Dr. McLaughlin, and perhaps the members from Kentucky and Michigan, having had the night to reflect on their attitude, may be able to join the rest of us in making it unanimous. There may be others who feel we should not dispose of this hastily without consideration and deliberation. If necessary, I think we should have a roll call.

Dr. SCHERESCHEWSKY. I may say that the chairman has modified his report by stating "except as amended at yesterday's conference."

Dr. McCORMACK. After having the matter clarified by Dr. Kelley, Kentucky remains in the same attitude it did yesterday.

Dr. SCHERESCHEWSKY. What is your pleasure regarding the modified report which Dr. Dowling has made?

Dr. McCORMACK. I move that it be received.

Dr. WILLIAMS. Second the motion that it be received and adopted as amended.

(Motion carried.)

Dr. SCHERESCHEWSKY. The next report is on interstate quarantine regulations, Dr. John S. Fulton.

Dr. FULTON. There is a sufficient number of copies of the report on interstate quarantine regulations for every person to have a copy, and I think no further remarks from me are necessary. I beg you to receive that in lieu of the reading of the regulations which are very long.

Dr. SCHERESCHEWSKY. I would say that the copies are here and would ask you, gentlemen, to help yourselves. What is your pleasure regarding the report?

(Moved and seconded that the report be distributed and adopted.)

Dr. SCHERESCHEWSKY. The next report is that of the committee on rural sanitation, Dr. W. S. Rankin.

RURAL SANITATION.

Dr. RANKIN. In making this report I am reminded of a story that is told of one of the Senators who lived in my State some years ago. This Senator was accustomed to indicate a great deal of personal interest in the affairs of his constituents. When he would meet a man he would ask about his family. One time he was going through court, and he was introduced to a man. "My friend, how is your father?" he said. "Senator, my father has been dead five years," the man replied. While walking through the court a few minutes later he met the same man and asked about his father. The man said, "He is still dead, Senator."

This committee has reported three times. We have made the same report each time. We have not changed our minds. If those interested in the report of the committee on rural sanitation will look up past proceedings they will find just where we stand. In making reports heretofore we have always received the indorsement of our position by the conference, and I do not see that it is necessary to jeopardize what the committee has done by submitting another report you might not be agreed upon.

Dr. McCormack. I move that the report be received and the committee continued.

(Motion carried.)

Dr. Lumsden. Since the conference is so generous in continuing the membership of the committee, I think we ought to change something, and I suggest a change in the name of the standing committee from that on rural sanitation to rural health work.

Dr. Schereschewsky. I think that is a very excellent suggestiton.

Dr. Lumsden. I make that as a motion.

(Motion seconded.)

Dr. Schereschewsky. The motion has been made and seconded that the name of the committee on rural sanitation be changed to the committee on rural health work. I think it is very commendable, because of the very much better connotation of that title.

Dr. Kelley. I do not think we need any discussion. I think every member of this conference is fully aware of the self-sacrificing manner in which Dr. Lumsden has devoted himself, heart and soul, for the last 10 years to the progress of rural health work. We know that progress has been made regardless of Dr. Rankin's very cursory dismissal of the committee report. Personally I feel that we should not pass over this item on the docket until we have a brief word from Dr. Lumsden as to what has been the progress as he sees it during the past year in this country. He is the man who gets the bird's-eye view of the whole country, and I would like to know if he sees anything to encourage us or otherwise in the progress of rural health work in the country.

Dr. Lumsden. Further on in the program is a subject, "Cooperative demonstration work in rural sanitation," and Dr. Rankin and I, and the other members of the committee, thought that under the discussion of that subject we might bring out certain general propositions which we have in mind for the consideration of this conference rather than delay the proceedings by taking up time for discussion at this moment, since the subject is mentioned specifically at that time.

Dr. Kelley. I accept Dr. Lumsden's apology and move that the motion be seconded.

Dr. Cumming. Is there any further discussion?

Dr. McCormack. I want to move that the conference extend a vote of thanks to Dr. Welch for this remarkable compilation on the study of communicable diseases. It is very remarkable, and as we get the time to go over it when we get home its value will become more and more apparent.

(Motion carried.)

Dr. Cumming. I feel I owe the conference an apology for my absence, but I promised to make an address to some railroad people and was placed on their program in conflict with this without my realizing it. The next report is that on trachoma, Dr. John McMullen.

TRACHOMA.

Dr. McMullen. In order that I may say those things which I want to say and leave those things which I should not say, I have reduced it to writing. There are two things in trachoma work which would seem to be outstanding in importance. One is to proceed and find the cause of trachoma and investigate tentatively the etiology; another thing which we need is something very definite as to what should and should not be done. Personally, I think the present status of the whole thing would indicate that those things which it is impossible to state definitely, such as whether this particular child is suffering from a communicable eye disease, should be excluded in view of the difficulty in making diagnoses. Even those follicular cases where they have been diagnosed as follicular conjunctivitis and where folliculosis is well marked, might well be excluded from school until cured, because they are readily curable and it should be done.

(Dr. McMullen read the following paper:)

The trachoma campaign during the present fiscal year has been much hampered on account of lack of funds, the appropriation for the prevention of the spread of epidemic diseases under which this work is conducted having been needed for plague work. It is hoped that during the next fiscal year a definite amount will be allotted and a trachoma program can be followed out. In spite of this handicap the trachoma hospitals were all kept going and busy. The importance of the field clinics has been more recognized and the numbers of those held each year has increased. During the past year 55 of these field clinics were held in various States with good attendance. The Red Cross—at least, the lake division at Cleveland—has become interested in the field clinics and has given them practical assistance. A number of States now have appropriations for trachoma and, in cooperation with the Public Health Service, have commenced a trachoma campaign. A trachoma clinic reaches a class of people sadly in need of help and who are practically at sea, so to speak, as to where to go for a cure. They therefore usually remain untreated—at least, without curative treatment—a burden to themselves and a menace to their neighbors. On account of the immediate results, which at times appear somewhat spectacular, the trachoma clinics produce a very healthy public health sentiment.

Trying to conduct a campaign against a communicable disease without a knowledge of the cause of that disease is an extremely difficult problem. We are all acquainted with troubles attendant upon the diagnosis of trachoma, because we are still in ignorance of the etiology. To distinguish between trachoma and allied conditions on paper is comparatively easy and convincing, but to do this practically is often very difficult and at times impossible in advance of observation and treatment. In routine examinations of large numbers in schools and other public institutions it is no easy matter to say definitely at the time which is and which is not a communicable eye disease. It has been suggested by some to permit those cases without apparent discharge from the eyes to attend school. We know, however, that trachoma is often present in a dormant state, and an accidental foreign body will immediately set up a condition which would be a source of danger to others in the school before being finally excluded. The record of many thousands of trachoma cases, including all ages, shows that between 1 and 2 per cent of them are blind in both eyes, between 3 and 4 per cent are blind in one eye, or about 5 or 6 per cent of them have lost either one or both eyes from trachoma. This is one result of trachoma, but it is thought that the loss of sight is not necessarily the worst. In view, therefore, of these facts and the difficulty of diagnosis, it is believed that not only should trachoma and those cases strongly suspicious of being this disease be excluded from schools but also well marked follicular cases, although diagnosed as follicular conjunctivitis, until cured. Such a course would be a great relief to both the health officer and ophthalmologist and would enable them to eradicate trachoma and allied conditions from the school to much better advantage. If the folliculosis is not trachoma it affords a favorable medium for the growth and spread of this disease. It is hoped that the section on ophthalmology of the American Medical Association may take some action along this line next week. After July 1 of this year I am informed by the bureau that a larger allotment of funds will be made for trachoma, and it is the intention to then extend and enlarge the work in cooperation with the State boards of health.

Dr. McCormack. In moving the adoption of this report I am instructed by the State board of health of Kentucky to offer the following resolution:

(Dr. McCormack read the resolution relative to trachoma.)

Dr. McCormack. I move the reference of this resolution to the committee on resolutions.

Dr. Rankin. I would like to hear from the Public Health Service as to the last section of the resolution. I am for that if the Public Health Service advocates it, but I am against establishing a division for everything that comes up. If the service favors it and Dr. McCormack can give any good reason for it, I am for it.

Dr. McCormack. I presumed the committee on resolutions would consider it and we would be given an opportunity to when it came in.

Dr. Cumming. I would suggest that we take that matter up when the resolutions committee reports.

Dr. Rankin. I think it is perfectly safe with the resolutions committee.

Dr. Nicoll. May I ask what may appear to be rather an ignorant question, but one in which I am vitally interested? Can Dr. McMullen give us very briefly a statement as to what trachoma is, whether it has a bacteriological basis, and how health officers or State officials are to establish as to whether a local outbreak of apparently more or less chronic conjunctivitis is trachoma or not. We had such an outbreak on Long Island, and it was with very great difficulty that I could get an agreement as to what it was. I think we took into consultation members of the Public Health Service. We ran up against bacteriologists and other people, and I am not sure even now whether we had trachoma or not.

Dr. CUMMING. Is there any further discussion?

Dr. CHESLEY. I haven't anything much to say on this subject except I think the members of the conference ought to know that the State of Minnesota is very much indebted to the service for the work done by one of Dr. McMullen's assistants on the Indian reservation last fall and winter. Our Indians are now becoming citizens, and when they become citizens the tribal fund is distributed so that it is no longer available for maintenance of reservation hospitals. Therefore no treatment is secured and the Indians affected have no treatment and they go into schools with the whites. Complaints are made all the time. Our legislature refuses to consider the subject of appropriation for trachoma, so that all the assistance we have been able to get is through the Surgeon General and the efforts of Dr. McMullen, who himself made an investigation following the investigation made 12 or 13 years ago by Dr. Taliaferro Clark, which brought before the people of the United States the trachoma situation as it was never before outlined. On behalf of Minnesota I wish to express the gratitude of the State board of health for the work which they have done and which they have offered to do in the future if we would supply hospital facilities for them.

Dr. HAYNE. I also want to thank the service for the services rendered in South Carolina in regard to the trachoma situation there. Dr. McMullen treated some sixty-odd children in some little town in the State, all of whom are now attending school, and have had no further complaint from the folliculosis, trachoma, or whatever it happened to be. We have had extremely acrimonious discussions in the State regarding it. I think it is exceedingly important that we should have some sort of a standard. You all know the discussions that have been carried on over chicken pox and smallpox. In diseases like that where we have no laboratory tests that are worth anything diagnosis means personal observation, experience, and personal opinion, and since that is the basis of diagnosis there will always be acrimonious discussion because the individual always thinks he has had as much experience as another individual.

Dr. WELCH. I wish to add my expression of appreciation for the work done on trachoma in Alabama. Like Dr. Hayne, I have had some difficulty in getting eye, nose, and throat men to agree with representatives of the service on the diagnosis. There have been several rather menacing foci in several parts of the State in the rural districts. There we have more trouble. The service operated on practically 100 per cent of the cases found, and we feel the work has obliterated in those particular localities where the work was done the outbreaks which had occurred there. Very recently in one community we had an outbreak covering a large area of three schools. Representatives of the service operated on all of the cases found with satisfactory results. The State board of health of Alabama has taken the position similar to the one we took in smallpox and chicken pox—when in doubt, call it trachoma.

Dr. MILLER. I want to express the appreciation of the State board of health of Tennessee to the United States Public Health Service for its assistance and work among the mountain people along the lines of treating trachoma. We have two hospitals there. A few years ago we could not get our State legislature to help us at all. We had to take from the epidemic fund what little we gave to Dr. McMullen. The last legislature gave us $2,000 to fight trachoma in one little county. We have a hospital in Swiss County now under the direction of Dr. McMullen, and one in eastern Tennessee. We have trouble with the specialists. They will turn down any case you send to them as not being trachoma, but if you can get the case away from the specialist and send it to one of Dr. McMullen's hospitals he will go home shouting and happy in six weeks.

Dr. HAYNE. It might be of interest to the conference to know the decision of the attorney general in our State in regard to a disputed case. If the State board of health sends an expert to determine whether a case is smallpox or chicken pox, or trachoma, and that expert rules that it is trachoma or smallpox that is final according to the ruling of the attorney general, and I have no doubt that the attorney generals of other States will make similar rulings.

Dr. DILLON. I just want to voice again the questions that Dr. Nicoll raised. If Dr. McMullen can give us any enlightenment on the differential diagnosis between trachoma and some of the other eye conditions it will be interesting. I want to express our appreciation of the work that Dr. McMullen and his assistants are doing. We have recently been confronted with a school physician who stated that 90 per cent of the children had trachoma. This is a school in a city of 50,000 people, and you can draw your own conclusions as to the ridiculousness of the statement.

Dr. CLARK. Before Dr. McMullen gives his opinion of the differential diagnosis I should like to say that trachoma can be recognized by one who has had experience with the disease. To show you how certain that is, a number of years ago I made a survey of trachoma in West Virginia and certain counties in the State of Virginia that outlined quite clearly the infected area. About two or three years afterwards I was working in South Carolina examining school children and making a special study of school children in the cotton-mill villages. These operatives, as you doubtless know, are recruited from the mountain sections of Virginia. I found in one of these communities one child in school with trachoma. On asking him where he was from, he said the State of Virginia. "You came from Dickinson, Scott, or Lee Counties," I said. This child was from Lee County in Virginia. I think that shows we should know what we are talking about.

I am going to say something else that will make you health officers think I am talking through my hat. A number of years ago I started to talk about child hygiene. My talks apparently did not fall on very fertile ground, but we have come to realize that child hygiene is one of the important functions of a State board of health. Take the subject of the control of communicable diseases—we have established quarantine for years and we have communicable diseases, especially those diseases that can not be determined by bacteriological examination. We have not accomplished much by means of compulsory quarantine. Quarantine after a definite diagnosis has been established does not amount to a row of pins. The damage has been done. We see the spread of smallpox because it is diagnosed as chicken pox. When we can get the public educated to appreciate the fact that the beginning of a sickness, especially in childhood is the most dangerous to the community, and if you could get the school authorities to exclude any child even with a cold which might be the beginning of a very serious outbreak of measles or whooping cough or other diseases, and have them assist by establishing voluntary quarantine, then we are going to accomplish something. This is just in agreement with what Dr. McMullen has himself said. When you find a condition which simulates trachoma, a disease which has disastrous results, you should not hesitate; you should do certain things which he does to a child to put the eye in good condition—an operation which will cure trachoma, if it is trachoma, before it has time to do any damage.

Dr. DOWLING. I do not know what explanation Dr. McMullen will give, but as one who has had experience in eye work, I have recently had called to my attention cases of trachoma and two of what I regarded as the best oculists in the community disagreed. Personally, I was firmly of the opinion that it was trachoma. I do not know what Dr. McMullen can offer to convince anyone that it is trachoma except people who are familiar with seeing it and know it when they see it. It is a matter for education and I do not know how we are going to educate them.

Dr. MCCORMACK. It is a distinct pleasure to express at this time the appreciation of the Kentucky State Board of Health to the Public Health Service and Dr. McMullen personally for the work which has been done. We are a little concerned as to the diagnosis. We know we have a condition there that is rendering many people blind. These conditions have been repeatedly cured by Dr. McMullen, who is getting results. Under his able guidance we have a special bureau for that work now, and we are repeatedly wiping out this disease in different sections. We feel we owe it entirely to the Public Health Service and Dr. McMullen.

Dr. BOUDREAU. We in Ohio have carried out quite a program for trachoma prevention for the last year and a half. We feel that our success is largely due to Dr. McMullen. In the last year and a half we have examined more than 110,000 school children, and we have found more than 900 cases of what we consider are cases of trachoma. Over 700 of them have been operated on by Dr. McMullen and his assistants. We have had very little difficulty, because we have had Dr. McMullen present at most of these clinics. I feel we owe a very large debt of gratitude for Dr. McMullen's excellent services.

Dr. KNIGHT. I wish to express appreciation of the work done in southeastern Missouri by Dr. McMullen and his assistants. The situation in Missouri is that specialists need education from Dr. McMullen. There is very great divergence of opinion. In one town with a school population of about 2,000 I diagnosed 229 cases as trachoma. A specialist from Kansas City confirmed that, but changed his mind when a local physician said it was not trachoma. The State board of health has requested that further aid be given from the service during the next year.

Dr. CUMMING. I am sure that Dr. Nicoll is carrying away with him a very clearly defined definition of what is trachoma. If anybody had asked me 20 years ago I am sure I could have given a very clear definition. After 20 years I must confess that it is very difficult when you get down to the border line. I have concluded that if you get a cure within a reasonable time it is trachoma, otherwise it is not. I hesitate to think what would happen to Dr. McMullen if the Volstead Act had not been passed before all these bouquets had been thrown at him. On behalf of the service, I want to thank you for your expressions of gratitude of Dr. McMullen's work. Dr. McMullen, do you want to tell Dr. Nicoll what trachoma is?

Dr. McMULLEN. I would be very glad if I could definitely answer that question in all instances. Having been in trachoma work for a number of years, I found it absolutely necessary to establish a standard whereby I could differentiate what was and what was not trachoma in the absence of more definite knowledge of the etiology. It can be stated that trachoma is an inflammation of the conjunctiva, which is accompanied by hypertrophy and the so-called trachoma granules. These changes in an eye constitute trachoma. The pathology of the two are practically identical. Clinically, we know that they are often very similar. I think most ophthalmologists will agree, and I think that is a conservative way to put it. When we have the hypertrophy, the trachoma granules and the pannus accompanied by some cicatricial tissue in the conjunctiva, most of them agree that we have trachoma. I do not know that even this is unanimous. But trachoma does not commence with cicatricial tissue. It takes more or less time, months or years, to produce these results. It is agreed that trachoma lies dormant for months, more or less, or possibly years, or until some exciting agent occurs to set up that condition which we recognize as analagous to acute granulations. It is in those cases where the pannus has not definitely taken place, where the corneal ulcerations have not yet occurred, where the formation of cicatricial tissue has been delayed or, if you please, it has been covered up, so to speak, by an acute exacerbation rendering it impossible to see the real condition. It was just this difficulty of diagnosis that led me to suggest the plan to exclude from school all those conditions which were suspicious of trachoma until they were cured.

We all recognize that it is not easy to cure a real case of trachoma and that relapses are prone to occur. I presume that is the reason some ophthalmologists state that the disease is never cured. I saw a statement recently by a doctor—I think he was a Tennessee man—that there is no trachoma in east Tennessee, and that this disease is never cured. Our experience, covering a number of years, and which includes east Tennessee, shows absolutely to the contrary. The standard, then, which we have taken in our trachoma work is a case of conjunctivitis which has more or less discharge, more watery than purulent, hypertrophy of the conjunctiva, and in which the granulations are present to such an extent that the small blood vessels can not be seen and traced as in the normal conjunctiva. The granulations are deeply set *in* the conjunctiva rather than *on* it. These blood vessels either are not seen at all or can not be traced uninterruptedly due to the hypertrophy and deep-set trachoma granulations. If other members in the same family are found to be affected, the true nature of the disease is disclosed as communicable. My attention was recently called to a case of trachoma in a boy by one of the school physicians in one of our large cities. The case applied at an eye dispensary and was seen by a number of ophthalmologists. The case was diagnosed as trachoma by some and follicular conjunctivitis by others.

Another day I saw the same case, and another specialist, who was not told of the previous discussion, promptly diagnosed it as a case of follicular conjunctivitis and ordered the boy into the hospital with the intention to operate. It is absolutely impossible in the light of our present knowledge to get anything like unanimous opinion among the medical profession. In the meantime health officers of the various States are in doubt as to what to do with these children in the schools. I understand that in the city of Philadelphia any follicular condition that is at all marked is excluded from the school until cured. The leading ophthalmologists in that city say the way to cure is by operative measures. They also state very emphatically that they have never seen any bad results from grattage properly performed for either follicular conjunctivitis or trachoma. Some of my ophthalmological friends admit that they do not know anything about trachoma. They see little of it and are practically never called upon to make routine examinations of schools and public institutions, and there is where we find difficulty in trying to be consistent in our diagnoses. We are compelled to make a diagnosis then and there, and it has been my habit to make the record under three headings or columns: First, trachoma; second, suspicious; and third, conjunctivitis. Under the third we put everything that should be treated, but is not of a communicable nature. We simply ask the recorder to place the case under the first, second, or third columns and obviate any reference to disease, and the pupils do not know why their names are taken.

Dr. Hurty. Does your treatment cure these cases absolutely?

Dr. McMullen. Absolutely. We are also justified in curing the follicular conjunctivitis by operation, but in operating on these cases we must remember that the follicles are merely *on* and not *in* the conjunctiva and can be removed with practically no cicatricial tissue resulting.

Dr. Cumming. I may state that about a year ago I requested a committee of eminent men to write an opinion as to the definition of trachoma in connection with immigrant court cases. No fatality has been reported as yet, but they have reached no decision.

Dr. McCormack. I believe the matter ought to be just a little more clarified in answer to Dr. Nicoll's question, which is a definite question. The cases of trachoma that we have had in this country have been treated by various methods for many years ineffectively. They have been treated over long periods of time by methods that alleviate the suffering for the time being but they are showing exacerbations of the disease from time to time afterwards. Now, the treatment given by Dr. McMullen and his assistants has simply been done all at one time, and the operation is successful in a large majority of the cases. Of the border-line cases, where it is difficult to establish a diagnosis, they are sure to be relieved by treatment. This is certain, because those not trachoma would probably have been relieved without treatment and are relieved with the treatment. Then why delay treatment while these distinguished gentlemen are discussing a point that has no more practical value than mountains on the moon? The thing we want to do is to get rid of trachoma, and if in doing that several hundred children suffering from conjunctivitis serious enough to bring it to the attention of the examining physician are treated why delay and give it a chance to become cicatricial or until the child becomes blind? Why delay when a simple operation entirely devoid of danger which produces no complication will relieve him of whatever condition it is with which he is confronted. It seems to me that the matter is one we need to go to the medical schools with.

Dr. Cumming. If there is no further discussion, what is your pleasure with reference to this report?

Dr. McCormack. I move that the report be received and approved.

(Motion carried.)

(It was moved and the motion carried that the meeting should adjourn to meet again at 2 p. m.)

AFTERNOON SESSION, JUNE 3, 1921.

The conference reconvened at 2 p. m.

THIRD INFORMAL REPORT (1920-21) TO STATE HEALTH OFFICERS ON THE WORK OF THE BOARD ON EXCRETA DISPOSAL.

Dr. Stiles submitted the following report:

During this past year the board on excreta disposal has been working chiefly along three lines, namely: (1) Underground water pollution, (2) the fly problem, and (3) existing laws and regulations.

(1) *Underground water pollution.*—In May, 1920, I reported to you that—

"It has been found possible to maintain an experimental pit privy for 4 months within 6 to 10 feet of wells without demonstrating bacterial pollution of these wells, although chemical pollution with salt was washed through within 8 to 15 days. The bottom of the pit in this case is 6 feet above ground water, and obviously the intervening barrier of sand is still sufficient to protect the ground water. Time now remains an important element of the variable value of x."

It is this experiment in particular in which I believe you will be interested.

The pit in question was at a center point, from which there radiated 11 wells at distances varying from 6 to 75 feet, and extended 8½ to 14 feet lower than the bottom of the pit. These wells were examined bacteriologically and all except No. 9 (at 75 feet) ran negative for *Bacillus coli* from August 16, 1919, to February 2, 1920, namely, during the period before the pit was dosed. On February 2, 1920, dosing of the pit with human can-material excreta began, and this continued regularly 6 days per week until the total amount of inserted excreta reached 176 gallons on April 23, 1920. All wells, except No. 9, already mentioned, practically continued to run bacteriologically negative until May 22, namely, a period of 110 days. During the latter part of this period, namely, from April 7 to May 22, *Bacillus coli* was confirmed irregularly in several of the wells, but not with sufficient regularity or amount to justify the conclusion that the pollution came from the pit. Accordingly in last year's report I used the conservative expression "without demonstrating bacterial pollution of these wells." Samples of water taken from the wells on May 22, 1920, namely, the day I left Wilmington, N. C., to attend your meeting last year, confirmed as pronounced *Bacillus coli* pollution in four wells in addition to No. 9. The expression "4 months" used last year was in round numbers for 3⅔ months. Actual confirmation of what we were willing to call pronounced and continuous pollution of 4 wells, distanced 6, 12, and 75 feet from the pit, was obtained in water samples taken 110 days after dosing of the pit began. During one week in June all 11 wells confirmed *coli* contamination. This intense pollution began to clear up in July, and by August 1 the wells were practically clear again.

The important point arises whether the pollution in these wells resulted from the pit or from some other source. In this connection it may be stated that if the pollution traveled from any known fecal mass other than that in the pit it traveled farther than it had to go from the pit to the wells. Ground-water levels were taken throughout the experiment and the measurements show a gradual rise of 2 feet from February 2 to May 9; then a fall of 1 foot to June 21; then a stationary status to July 6; then, again, a rapid rise of 1½ feet to July 29, followed by a fall. Accordingly, just prior to the pollution there was a rise followed by a fall, and just prior to clearing there was another and higher rise, which was later followed by a fall.

If I claim positively that the pollution came from some more distant source other than the 176 gallons of excreta in the pit, I will not take offense if you reply that I have a difficult thesis to maintain; conversely, if I claim positively that the pollution of the wells came from the pit, I will not be surprised if you reply that the results were so sudden and so startling that you would like to have the experiment repeated in another locality, but on similar soil, before you commit yourself definitely as to the interpretation. What my present view is need not be divulged, but I may state that we are now repeating this experiment and we propose to use *Bacillus typhosus* as well as *B. coli* in this second test.

You will, of course, appreciate the fact that an experiment of this kind, involving regular examinations of a number of wells, before and after pollution of the pit, is one which requires months of time.

In connection with the subject of pollution of ground water, it is of interest that regulations of some boards of health prohibit the use of abandoned water wells for excreta disposal, that some boards advise against digging privy pits into ground water, but that at least one local board advises that the pit should be dug 3 to 5 inches into ground water.

(2) *The fly problem.*—Last year I reported to you that we had devised a double screen for the ventilating flue by which the privy can be turned into a flytrap. It has been our desire, however, also to find some chemical which would kill or repel flies from privies more satisfactorily than those now in use. Many board of health regulations advise various drying powders and various liquids for this purpose, but some of the suggestions have not seemed to us to solve the problem. What is really needed is a fly repellant, which will also kill fly larvæ and which is both economical, easily obtainable, and not dangerous.

After many unsatisfactory experiments a new lead was obtained, but before we followed it out we were pleased to learn that Dr. J. W. Cox, loaned by the Surgeon General to act as health officer of Arlington County, Va., had just anticipated us. In fact, he had our idea in practical and successful use in can privies before our first experiment was made with the substance we had in mind, namely, water-gas tar; also known as oil-gas tar.

Gas plants have two products known as coal-gas tar and oil-gas tar, or water-gas tar. This water-gas tar is sold at prices varying from 5 to 27 cents per gallon.

Dr. Cox puts about a gill of water-gas tar plus a gill of kerosene in each privy can. The effect is nothing less than startling to a person who is accustomed to see swarms of fly larvæ in the privy with the characteristic privy odor. Flies do visit the pail treated with water-gas tar, but they only exceptionally alight upon the excreta. In a number of pails examined by the personnel of the board, fly larvæ were not found, although at the time of the examination there was an abundance of flies in the vicinity, and they were breeding in unprotected cans not far away. The odor of the privy is very materially improved by the tar.

In our Wilmington experiments, we are testing out water-gas tar from various cities and in various ways. While the experiments are not completed, I feel justified in giving you the following preliminary report.

(*a*) The water-gas tar obtained from different gas plants varies considerably in certain physical characters and also to some extent in effectiveness. Accordingly, it seems at present fundamental that each health officer who may wish to use it should establish by actual test the value of his local product before he adopts it.

(*b*) In our experiments thus far, it appears quite clear that water-gas tar has less prompt effect upon the rat-tailed larvæ of the fly genus *Eristalis* than it has upon larvæ of the house fly, *Musca domestica*. Its failure to kill *Eristalis* promptly is not, however, of special importance, since this fly is so much less common in houses than is *Musca*.

(*c*) While the use of water-gas tar has given very striking results as a deodorant and a fly repellant in privy cans and as a deodorant in the scavengers' wagons, its use on a large city dump was of only brief and temporary benefit.

(*d*) Water-gas tar is distinctly inflammable and it burns with not a high flame but with profuse black smoke. Neither Dr. Cox in Arlington County nor we in Wilmington have had any fires resulting from its use, but the caution seems justified that if it is used in privies which are located close to frame buildings the families should be cautioned not to throw into the can any burning matches, cigar stumps, cigarettes, etc. If a fire should start, however, warning will be given promptly by the dense black smoke.

(*e*) It is not as yet clear how far the use of water-gas tar will be practical and of value in vaults and in pit privies, but it is clear that this substance will be of less value in pits than in cans.

(*f*) We have not yet tried water-gas tar as a substitute for the burning of tar paper, required by some board of health regulations, during the emptying of privy vaults, but this appears well worth a trial in some locality where privy vaults are in vogue.

In summary, thus far I feel thoroughly justified in stating that water-gas tar from certain gas works has proved to be of distinct value as a deodorant and a fly repellant in can privies, and also as a larvicide for *Musca* in scavenger wagons and in the sawdust disposal system, but the entire application of water-gas tar to excreta disposal is only in its initial stage and we must be prepared for possible failure when we use the tar from some localities and also for possible failures if we expect a too broad application of its use. Water-gas tar seems to have distinct promise for certain uses, but if the idea is overworked, it will fall into disrepute.

(3) *Existing laws and regulations.*—The study of existing laws and regulations has been no small undertaking, but all indications are that the time and effort will have been well spent. The uniformity of the provisions in certain localities clearly demonstrates that relatively uniform regulations are a distinct possibility; on the other hand, the diversity found to exist in other localities shows the need of placing at the disposal of health officers a general comparison of requirements and of methods of procedure.

Take, for instance, the important question of the distance of a pit privy from a well. Board of health regulations vary in this requirement from 20 to 300 feet; while one local board requires that the distance between the privy and the well shall be equal to twice the depth of the well—in other words, if the well is 200 feet deep, the privy must be 400 feet away, but if there is a surface well 10 feet deep, the privy can be moved up to 20 feet. Few regulations consider the question of the ground-water level or of the nature of the soil, or the nature or depth of the well.

Under our present plan of work, we are summarizing each one of the 804 separate thoughts and headings, involving excreta disposal, as found in existing laws, rules, regulations, and advice; and these summaries are being presented to the members of the board for consideration in connection with our experimental work.

One of the most striking points in connection with the laws and regulations is the fact that in some localities every imaginable formal and red-tape obstacle seems to be placed in the path of the family which wishes either to build a privy or to have it cleaned, while in other localities regulations show the difficulty encountered by boards in inducing families to build privies and to have them scavenged.

Another striking point is that one local board of health requires that as soon as a case of typhoid fever is discovered at a home, a privy must be built, but that this must be removed when the patient recovers.

Many boards of health seem to have more confidence in the ease and efficiency of various methods of disinfecting excreta than has been developed among the personnel of our board.

The foregoing citations seem to justify us in the feeling that a summary of existing laws, rules, regulations, and advice on the subject of excreta disposal will be of distinct practical value to health officers.

Legal definitions: In studying existing laws, we have been impressed by the fact that the names and definitions used in excreta disposal in different parts of the country are by no means uniform or standardized. The board is endeavoring to define for its own use each important word of legal value. If it becomes possible for State and local boards to accept uniformly either our definitions or some other definitions, we believe that the legal and also the technical phases of the subject will be simplified.

(4) *Chemical disinfection of excreta.*—As yet we have obtained only limited encouragement in our studies on the disinfection of human excreta. Summarized briefly, under present prices for labor and chemicals we see no immediate hope for a practical, economical chemical mass disinfection of excreta beyond the use of a chemical privy or the occasional chemical disinfection of a vault privy, which may be necessary. Further, we can definitely abandon all thought of a chemical disinfection of polluted mines and polluted fields as too expensive unless by chance, in exceptional cases, some waste material, as some mine waters or sea water, can be turned in to cover the ground.

(5) *Temperature as a factor in privy sanitation.*—We have been studying the question of temperature, as influencing the development of hookworms and flies, in the hope of obtaining new leads in the privy problem. These studies have resulted in the conclusion that the fly and the typhoid and dysentery bacilli should be the chief criteria upon which we should base our biological deductions in regard to privies, and that hookworms, *Strongyloides*, protozoan, and other zoo-parasitic infections are to be considered as secondary and less important criteria. This conclusion—somewhat heterodox for a zoologist to express—is based chiefly upon the point that factors which inhibit the develop-

ment of flies will suffice to inhibit the development of hookworms and other zoo-parasites, although the converse does not obtain so uniformly; and factors which inhibit the spread of flies and bacteria will inhibit the spread of the zoo-parasites, although the converse does not obtain so uniformly.

Turning now to temperatures, it may be stated that we know more about the hookworm thermometer than we do as yet about the fly thermometer, both of which are summarized in brief in the following tables:

CONDENSED HOOKWORM THERMOMETER (INTERNATIONAL OBSERVATIONS).

° C.	° F	
8-10	46.4-50	This is the lowest demonstrated temperature at which hookworm eggs, placed under favorable conditions, have been observed to segment and to hatch out larvæ that reach the infecting stage.
8-18	46.4-64.4	In this range of temperature hookworm larvæ are sluggish to motionless.
20-35	68-95	Favorable to hookworm development and motility.
25-30	77-86	Optimum for development of hookworm eggs and larvæ and for motility of larvæ.
35-40	95-104	Less favorable to hookworm development and motility.
40-50	104-122	Eggs have been observed to hatch at 40° C., but in general constant temperatures above 37° C. are reported as unfavorable or fatal for eggs and larvæ. Both eggs and larvæ, however, can stand 40 to 50° C. for a few minutes and survive.
50-60	122-140	Fatal to eggs and larvæ in 1 to 5 minutes.
60	140	Fatal to eggs and larvæ almost instantly.

CONDENSED HOUSE-FLY THERMOMETER (FROM LITERATURE).

7.2	45	Eggs of *Musca domestica* did not develop until brought into a warmer temperature.
12.2	54	Larvæ had not matured at end of 8 weeks.
15.6	60	Eggs have been hatched in 12 hours.
19.3-23.9	65-75	Duration of life round was 3 weeks.
23.9-26.7	75-80	Eggs have been hatched in 8 to 12 hours.
32.2-36.7	90-98	Larvæ mature in shortest period in fermenting materials.
37.8-43.3	100-110	Larvæ leave the hotter portion of the manure.

From the foregoing it would appear that at temperatures below 7° C. (45° F.) fly typhoid and hookworm development are excluded, hence at this temperature and under, the privy problem reduces itself to a question of bacterial diseases spread by water and by vertebrates.

From 8 to 18° C. (46.4 to 64.4° F.) the possibility of hookworm infection must be admitted, but since the worms are sluggish at these temperatures it is clear that skin infection will not be likely to occur, but that infections which do occur will be by the mouth and therefore will be light cases.

From 54 to 75° F. (12.2 to 23.9° C.) the possibility of fly typhoid must be admitted.

As soon as the temperature passes above 20° C. (68° F.) the excreta (hence the privy also) become more dangerous, as these higher temperatures are more favorable both to hookworms and to flies.

As 25 to 30° C. (77 to 86° F.) represents the optimum for the development and motility for hookworms, it follows that the infections which occur at these temperatures are more likely to be through the skin and more severe than infections which occur at lower temperatures.

As 23.9 to about 36.7° C. (75 to 98° F.) represent the optimum for fly development, it follows that fly typhoid is more likely to occur in this range.

The obvious conclusion is that at a temperature of 23.9 to 36.7° C. (75 to 98° F.) human excreta reach their greatest potential danger, hence that this represents the temperature range in which the problems of the privy and of excreta disposal reach their greatest potential importance.

Above 35° C. the temperature is less favorable for hookworms, and above 37.8° C. it becomes less favorable for flies (hence also for fly typhoid). Accordingly, the problems of the privy and of excreta disposal begin to decrease in importance above 35° C.

With the foregoing temperature data before us, the conclusion is obvious that, given other factors (such as moisture and shade) as equal, the privy problem becomes more acute in proportion to the length of the season when the temperature varies between about 25 and 35° C.; in other words, that it is more important for our Southern than for our Northern States, hence it is more important for the South than for the North to have good sanitary conditions in respect to excreta disposal.

The mention of flies reminds us that the zoological data contained in many board of health regulations are somewhat confused from the present point of view. For instance, according to some regulations flies and chickens are not animals, although these same regulations do not classify them either as plants or as minerals. It is apparent that many regulations use the word *animal* in the sense of *mammal.*

(6) *Sawdust disposal method.*—Last year I reported to you that we were trying out a method of composting night soil with sawdust. The experiment is still being followed and the method has continued to give good results. One weak point has, however, developed, namely, our neighbors' chickens have discovered the fields, and they scratch through the sawdust down to the excreta, thereby exposing feces whereon flies lay their eggs. While pigeons, mocking birds, and sparrows have been a distinct aid to us, chickens have proved to be an unmitigated nuisance.

The growth of grass on our sawdust plots has surpassed all expectations, but it is still too early to conclude whether our fertilizer is of ephemeral or of more permanent value.

Except for the occasional exposure of feces due to the energies of the chickens or to the lack of energy on the part of the man who covers the night soil with sawdust, this disposal method is, up to date at least, a distinct success.

Mr. Emerson. Dr. Stiles's world-wide reputation as an authority on rural health problems naturally leads one to accept all of his rulings without question. Furthermore, such acceptance might well be without careful thought or digestion. Therefore, I believe that two of the points made in that portion of his paper relating to the proximity of privy vaults to drinking-water wells should be emphasized. First, that the soil chosen for this experiment was sandy and that the bottom of the pit was above ground level; and second, that Dr. Stiles has as yet drawn no definite conclusions.

It is apparent that in soil of the particular character, and with ground-water level at the elevation obtaining in this experiment, conditions were favorable for maximum purification of liquids passing from the privy vault toward the drinking-water well. These experiments have been under way for only a short period of time as compared with occupancy of a farmstead for generation after generation, with resulting pollution of a well in rather close proximity to the privy vault.

We know that in rural districts we are still experiencing isolated foci of infection, and the only commodity which can not be definitely excluded is the drinking-water well, where sewage pollution is evidenced by bacteriological analysis year after year.

The reason for these remarks is simply that the success of the engineering profession in this generation is due, to a large extent, to liberal factors of safety which were selected by designers of the past. Bridges constructed years ago, when traffic was light, are to-day bearing heavy motor-truck traffic without undue vibration or sagging. Our factor of safety as regards the well in the rural districts is to separate it as far as may be from the privy on the same or adjoining property. Let us not give up this factor of safety and conceive the idea that there is no possibility of sewage-pollution traveling but a few feet. I heard it definitely stated last fall by a health officer of a populous county that sewage pollution would disappear in traveling 14 inches from a privy vault. Dr. Stiles has not given his final opinion. Let us await it, even though that opinion may not be forthcoming for several years.

MALARIA.

Dr. **Fricks.** In being called upon to open the discussion on malaria, I understand that I am expected to give you a brief outline report of malaria investigations and control demonstrations which have been conducted during the past year, or since our last meeting. I take it, also, that my remarks should be directed particularly to the cooperative program for malaria control under which we are now working in 10 of the Southern States. My reasons for this assumption are, that while not all the State health officers here present are interested in malaria, those from the South are intensely so, and their interest centers in practical malaria control methods which can be grafted onto their health programs.

Before we enter into discussion of the program for cooperative malaria control, however, it would perhaps be well to mention briefly the investigational activities which have been conducted within the United States during this period. This review will give us a clearer impression of the magnitude and variety of the malaria control problems which are confronting us. During the past year the United States Public Health Service, cooperating with the State health department of California, completed a series of investigations dealing with Anopheline mosquito production in rice fields. A report of these investigations is being prepared, but perhaps you will be interested to know that certain rice fields were found in which mosquito production was negligible, a very different situation from that previously observed in Arkansas and Louisiana rice fields. The United States Public Health Service also conducted other scientific investigations of malaria problems in the field. A field laboratory was established, first in Arkansas and later in southwest Georgia, from which these investigations were carried on. Considerable success attended the effort to devise some less expensive and more easily applied means of destroying Anopheline larvæ. Dr. M. A. Barber, in charge of the field laboratory, finds that insoluble arsenic can be successfully used as an Anopheline larvicide, and that the quantity required is so small as to be of little possible danger to human beings or live stock.

Investigations of quinine treament of malaria made by Dr. C. C. Bass in Bolivar and Sunflower Counties, Miss., resulted in the National Malaria Committee' adopting a standard treatment for malaria in the United States. This standard treatment consisting of 10 grains of quinine sulphate for adults, taken every night for eight weeks, after recovery from the acute attack, has been approved by the United States Public Health Service and concerted effort is being made to popularize it among the physicians of the South. It is felt that the standard treatment for malaria, as advocated, is a vast improvement on the quinine dosage now generally employed and that its widespread use will tend to reduce relapses and malaria carriers, or in other words, tend to effect complete and permanent cures of malaria cases and thus reduce new infections. The Bureau of Entomology is continuing its investigation of malaria-bearing mosquitoes at Mound, La. The Bureau of Fisheries is cooperating with the United States Public Health Service in continuing the investigation of fish control of mosquito production. Other governmental bureaus are showing an increased interest in the subject of malaria as it relates to reclamation and drainage projects. Thus we see that the malaria problems with which we have to deal are many, that they are being approached from various angles, and are being carefully and scientifically studied by different agencies.

Returning now to malaria control demonstrations conducted during the year, in which you are more directly interested, because many of you are parties to the cooperative agreement under which we are working, I will state briefly for the information of those who are not familiar with the cooperative program for malaria control, that this is an arrangement entered into in the summer of 1919 between 10 State health departments, the United States Public Health Service, and the International Health Board, in order to promote the control of malaria in the United States by the properly constituted health authorities. It provided that the United States Public Health Service should assign to the State health department, upon request, an officer trained in malaria control who would make malaria surveys, prepare estimates of costs, and supervise construction work; that the State and local health authorities would provide funds for control measures and indicate the places where they should be conducted; that the International Health Board would supplement these funds where necessary. These demonstrations in malaria control were to be undertaken in urban communities and extended as rapidly as feasible, and to be transferred as soon as possible to the proper local health agencies.

In beginning operations in this new field, or least under this new plan, it was necessary to have a written program clearly defining the procedure to be followed and the duties of the cooperating agencies. It was not understood, however, that this program should be absolutely inflexible, or that the cooperative program would be equally suitable to every State, and that it would be taken up with equal enthusiasm by every State health officer. It was understood that the health problems of the different States were different, and that the health departments had reached different stages in their development. Hence, we have tried in every way to fit our cooperative program to the needs and wishes of the State health officer concerned so long as its basic principles were adhered to.

Our cooperative program for malaria control has now been in operation for two years in 10 Southern States and working under it urban communities are conducting antimalaria operations, as follows:

In Alabama, 5 old towns in which malaria control was undertaken last year and to which we are still giving advisory supervision, and 4 new towns in which malaria-control demonstrations were started this year; in Arkansas, 8 old towns and 2 new towns; in Georgia, 2 old towns and 2 new towns; in Louisiana, 2 old towns and 1 new town; in Mississippi, 5 old towns and 5 new towns; in North Carolina, 3 old towns and 1 new town; in South Carolina, 3 old towns and 2 new towns; in Tennessee, 1 old town and 2 new towns; in Texas, 14 old towns and 7 new towns; in Virginia, 7 old towns; making a total of 51 urban communities in which malaria-control demonstrations were conducted last year and to which advisory supervision is being furnished this year, and 26 new towns in which we are making malaria-control demonstrations this season. The total cost of new construction work and maintenance of old work, as estimated for the present season, exclusive of supervision, is $106,462. This sum will be supplied by the different State health departments and the communities concerned.

In fairness to those State health departments which are attempting to expand the cooperative program for malaria control and graft it onto their present organizations, it should be stated that the list of communities undertaking malaria control under our cooperative program as given above does not include many communities which are being furnished advice relative to their malaria problems and its control and which are doing something less than is required under the cooperative agreement. In Alabama 32 such towns have been surveyed and are following the advice of a sanitary engineer in handling in a practical way their malaria problems. This is an ex-

State which probably could not be drained. In fact, there are large areas which could not be drained economically. In many of these areas the incidence of the disease is high, and it would be desirable if we could work out a plan by which the blood of the people could be sterilized by taking a certain dose of quinine for a definite period of time. Thus even though the malaria mosquito were present, one could not become infected, because the blood would be free of parasites. In this way the disease can be controlled.

We started out upon such a demonstration in 1915, and Dr. C. C. Bass was made scientific director of the work relative to the control of the disease by the use of quinine. At the beginning he was very enthusiastic as to the large possibilities of this particular line of endeavor, and as the work proceeded, of course, all of us gained a great deal of valuable experience as to its limitations.

The demonstration relative to the use of quinine resulted in working out a very definite policy in treating this disease. This work has shown, I may state very conclusively, that malaria carriers—that is, those who are infected with the disease and do not show active symptoms—can be disinfected, can be cured, within a period of two months, provided every adult who is infected with malaria should take quinine—10 grains—every night for a period of two months.

This demonstration has shown that as many as 90 per cent of them can be cured or can be sterilized. Of course, when you reduce the infection to that extent, the disease automatically decreases in incidence. Of course, the dose of quinine is graded according to age. The 10-grain dose is given to those 14 years of age and above, and the dose is graded according to age below 14. The adult is given 10 grains each night for a period of two months.

I might mention incidentally that this treatment is to be published in the near future, so that it will be at the disposal of all of those who want to use it in the Southern States. We have pretty well worked out a plan by which we can get quinine at about 40 per cent less than it is being sold to-day in the market. This will be put out in a standard package, on which will be written the standard treatment for malaria, and the stores of every State can obtain this treatment and place it at the disposal of the public, and those who are engaged in the control of malaria can work out a plan in each county, so that the people may be educated relative to the use of quinine in this way. While, of course, that would not necessarily result in the control of the disease, I think one of the most desirable things at present in the prevention of malaria is to get the people who are known to have the disease free of infection.

Our experience shows that very few, a relatively small percentage of people who come under the direction of physicians and who are infected with malaria, are actually cured. They have relapses. As a result, about 60 per cent of the people who have malaria this year carry the parasites over and have relapses next year; about 40 per cent of those who develop the disease next year are new cases. This is about the ratio between the old cases and the new cases. You can readily see the gravity of the problem, so far as curing the case is concerned. One of the great things is getting the people who have this infection cured. We feel that placing this standard treatment upon the market, would be a very effective way of getting the people to realize, as well as the physicians, that they should take this treatment at least two months. In that way, a definite result will be obtained, so far as this particular phase of the work is concerned.

The more we go into the problem of malaria, it seems to me that, briefly stated, malaria can only be controlled by using all of the methods which are at our disposal in a particular area. Assuming that we go into a certain county where there is a considerable amount of malaria, the first thing to do is to make a survey and determine the malaria problem in that county, see what part may be drained; how much use may be made of the quinine method, and work out the program in the control of malaria so as to utilize properly all of the methods and all of the information we have for the control of the disease. After having gone into this pretty carefully in our own State, we have come gradually to the conclusion that that is the thing for us to do, and of all the methods that have been proposed in the control of malaria, there are two methods that stand out most prominently. One is quinine; we must use quinine; we must get the doctors to treat their cases properly. The second thing is drainage.

These two methods are the agents that should be used, especially in the control of this disease. Screening is of only incidental importance, There are many tenement houses which can not be screened. A demonstration, which has been conducted in Louisiana, shows that a house that can not be properly screened is more dangerous if screened than unscreened, because the mosquitoes get on the inside, become infected, and are a dangerous element in the cause of sickness in that family; so that, while we have talked about screening a great deal, I think the two outstanding points we must advocate and stand on absolutely in the control of this disease, where it is prevalent, are quinine, sterilization of the blood, and drainage. But, of course, the procedure must be accompanied by extensive educational methods of the people and of the medical profession.

Dr. HAYNE. The subject of the control of malaria in the Southern States, and wherever it exists in the United States, is one of the problems, it seems to me, of vital importance.

I went through a suburb of Boston yesterday—New York quite a thriving town—quite a number of streets there. I passed block after block, containing probably hundreds of thousands of people, and

Take, for instance, the important question of the distance of a pit privy from a well. Board of health regulations vary in this requirement from 20 to 300 feet; while one local board requires that the distance between the privy and the well shall be equal to twice the depth of the well—in other words, if the well is 200 feet deep, the privy must be 400 feet away, but if there is a surface well 10 feet deep, the privy can be moved up to 20 feet. Few regulations consider the question of the ground-water level or of the nature of the soil, or the nature or depth of the well.

Under our present plan of work, we are summarizing each one of the 804 separate thoughts and headings, involving excreta disposal, as found in existing laws, rules, regulations, and advice; and these summaries are being presented to the members of the board for consideration in connection with our experimental work.

One of the most striking points in connection with the laws and regulations is the fact that in some localities every imaginable formal and red-tape obstacle seems to be placed in the path of the family which wishes either to build a privy or to have it cleaned, while in other localities regulations show the difficulty encountered by boards in inducing families to build privies and to have them scavenged.

Another striking point is that one local board of health requires that as soon as a case of typhoid fever is discovered at a home, a privy must be built, but that this must be removed when the patient recovers.

Many boards of health seem to have more confidence in the ease and efficiency of various methods of disinfecting excreta than has been developed among the personnel of our board.

The foregoing citations seem to justify us in the feeling that a summary of existing laws, rules, regulations, and advice on the subject of excreta disposal will be of distinct practical value to health officers.

Legal definitions: In studying existing laws, we have been impressed by the fact that the names and definitions used in excreta disposal in different parts of the country are by no means uniform or standardized. The board is endeavoring to define for its own use each important word of legal value. If it becomes possible for State and local boards to accept uniformly either our definitions or some other definitions, we believe that the legal and also the technical phases of the subject will be simplified.

(4) *Chemical disinfection of excreta.*—As yet we have obtained only limited encouragement in our studies on the disinfection of human excreta. Summarized briefly, under present prices for labor and chemicals we see no immediate hope for a practical, economical chemical mass disinfection of excreta beyond the use of a chemical privy or the occasional chemical disinfection of a vault privy, which may be necessary. Further, we can definitely abandon all thought of a chemical disinfection of polluted mines and polluted fields as too expensive unless by chance, in exceptional cases, some waste material, as some mine waters or sea water, can be turned in to cover the ground.

(5) *Temperature as a factor in privy sanitation.*—We have been studying the question of temperature, as influencing the development of hookworms and flies, in the hope of obtaining new leads in the privy problem. These studies have resulted in the conclusion that the fly and the typhoid and dysentery bacilli should be the chief criteria upon which we should base our biological deductions in regard to privies, and that hookworms, *Strongyloides*, protozoan, and other zoo-parasitic infections are to be considered as secondary and less important criteria. This conclusion—somewhat heterodox for a zoologist to express—is based chiefly upon the point that factors which inhibit the develop-

ment of flies will suffice to inhibit the development of hookworms and other zoo-parasites, although the converse does not obtain so uniformly; and factors which inhibit the spread of flies and bacteria will inhibit the spread of the zoo-parasites, although the converse does not obtain so uniformly.

Turning now to temperatures, it may be stated that we know more about the hookworm thermometer than we do as yet about the fly thermometer, both of which are summarized in brief in the following tables:

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The obvious conclusion is that at a temperature of 23.9 to 36.7° C. (75 to 98° F.) human excreta reach their greatest potential danger, hence that this represents the temperature range in which the problems of the privy and of excreta disposal reach their greatest potential importance.

Above 35° C. the temperature is less favorable for hookworms, and above 37.8° C. it becomes less favorable for flies (hence also for fly typhoid). Accord-the thought that came to my mind was: Who in the world feeds all those people? Where do they get their food from, and how in the world are they clothed? And the thought carried me back to the cotton fields of Alabama, Mississippi, and South Carolina, and the economic conditions that now exist there. It took me then out to the West, where the wheat is grown and where the food is made, and I thought of the economic conditions there. As I came up on my trip I saw that beautiful Capitol and wondered if the people we had in that Capitol were thinking of the problem that I thought of in regard to the people of the United States.

In South Carolina, in Georgia, and in Mississippi, Louisiana, Texas, and all the rest of them, we have this problem: That the white man will not live in a country where there is malaria; where malaria is to any great extent. He will take his family and move. He does not mind typhoid fever; he does not mind typhus fever; he does not mind smallpox to any great extent. He will not live year after year in a country in which his family have chills and fever, and in which his family can not be happy. It does not kill them, but it does sap their energy and prevents them from making a living and enjoying life, and any man will not live where his family can not enjoy life.

Now, the problem is a national problem. It is not confined to the South. It is utterly impossible for the impoverished South at the present time to take care of the malaria problem, and if the United States does not take care of the impoverished South they will lose the revenue from the cotton fields of the Southern States.

We went at this thing in South Carolina in a very small way. We only had three towns, and I would like to show you something about those three little towns. You would not call them towns here. You would not notice them if you went through them in an automobile. I hardly suppose you would even tax them. Down there we call them towns. There is the town of Bamberg, with a population of 2,500, that you would not rate as a town. You would call it a straggling rural district. We call it a town. It had 1,016 cases of malaria in 1919. We did work there—drainage; regular permanent work. We did not go and treat 2,000 people with quinine, because the mosquitoes were infected. We drained the place, and the place is now permanently free of malaria. It will take upkeep work to keep it free. That is a very small cost. The ditches have to be kept cleaned out. We drained 7 square miles of cypress swamp.

The economic loss to that small town was $50,800 in 1919; in 1920 it was $8,500. That small town saved $42,000 by this work. Did the work cost anything? It cost $27,000. Where did the money come from? The money was given by voluntary subscription in that small town. Seventeen thousand dollars of it was given that way.

The rest of it was given by the International Health Board and by the State of South Carolina by taxation. The work was under the supervision of an engineer of the Public Health Service.

Another town had 302 cases in 1918. In 1919 they had 411. We did the work, and in 1920 we had 53 cases. The economic loss in that town was $21,000 in 1919. In 1920 it was $2,650.

I want to tell you about another town in South Carolina. Hartsville is a little place of 3,624 inhabitants. In 1918 it commenced extensive malaria work through its town council and its board of health organization. This is in the same part of the State as Bamberg. Bamberg had 1,016 cases out of a population of 2,500. This town had in 1919, 10 cases out of a population of 3,624. We did work there which was simply supplementary to work already done. In 1920 the number of cases in that town was 4. These figures are a matter of record and can be verified. It is all shown on a very small map, which is a photograph of a large map.

We want to continue that work. We want to continue it in the South, not only in South Carolina. We want to be able to have white people move down there where, on account of its climate, you can make crops all the year round; where you can raise anything in the United States.

Why do people not go to the South? They have an idea it is hot all the time there. It is hotter in Boston right now than it is in Hartsville, Bamberg, or any of those places I have enumerated. We have cool nights. We have hot days, but we have sunshine more days in the year than they have in any part of this part of the world. It is a place where people can live all the year round with exceedingly little expense, because they do not have to keep warm in the winter time, as they have to do in a more northern climate. The land is fertile. It is not a one-crop place. We have got to induce white people to go there.

I lived in Montana one time. It is a good country, but when you get out there you are 500 miles from a tree. When you want to be comfortable in the winter time you have to dig a hole in the side of a hill and stay there until the winter is over.

We do not have those things in South Carolina or in the Southern States. The reason of the black belt is malaria. When you remove that black belt then you wipe out the blackening of that part of the country. The Negro will live where he has malaria, but the white man will not.

Dr. Dickie. Several years ago in California, we did some experimental work in malaria as a demonstration. We received a small appropriation from the State government, and did the work in northern California in a little town called Anderson.

We found a listless, indolent population, with 95 per cent of the inhabitants infected with malaria. We started out to give extensive treatment, operating a free clinic for the purpose. We drained the surrounding country, and the following year we reduced the actual number of cases to five. The next year half a million dollars' worth of property changed hands in the vicinity. Previous to that, we had an enabling act passed in the legislature calling for the creation of mosquito abatement districts. There had been quite a few of them established, but they had not been as satisfactory as we would have liked, because the revenue from the taxation is not sufficient to properly carry on the work, though we were able to get volunteers to do considerable work in the early spring.

We went before the legislature this last winter, expecting to get $200,000 to complete the work in the northern part of the State. We have discovered in California that some of our most fertile agricultural territory is infected with malaria, and in accordance with the experience of the gentleman who has just spoken, we also found that settlers will not go there; in fact, people are moving away. A great deal of the territory is being turned over at the present time to the Japanese, and they are carrying on the agricultural work there.

We have received $20,000 from the last legislature for this purpose. We expect to make a further demonstration. I think this appropriation will be sufficient to rouse the people of our State to the necessity of eradicating malaria once for all. I think it is only a question of a few years before we will eradicate it.

Dr. FERRELL. The cooperative demonstrations in malaria control, aside from showing that malaria can be controlled at a cost within the reach of the average community, have demonstrated the feasibility of cooperative effort of Federal, State, and local health agencies in dealing with health problems. The representatives of the various agencies have worked in entire harmony.

Definite reduction in the amount of malaria has been obtained, and the local authorities are becoming accustomed to spending money for health protection. Once the wisdom of making such expenditures is fully appreciated, we may expect to see communities provide for health work as regularly as provision is made for schools, roads, etc. The work, then, is exerting a wholesome influence in the development of permanent local health organizations.

Malaria is recognized by the laity, physicians, and public health workers as an outstanding health problem in many communities of the South, such as Bamberg, S. C., and the delta counties of Mississippi and Louisiana. There are, however, many towns and counties in which malaria is of much less importance. However, the degree of its importance has not been definitely determined. In such localities opinions differ as to the wisdom of using the available public health funds in measures for the control of malaria.

At present Dr. Rankin, in North Carolina, is conducting an investigation in Lenoir County to ascertain the extent to which malaria constitutes a menace to the health and economic efficiency of the people. It would be wise, no doubt, to have similar studies conducted in quite a number of sample counties. Once we have a reliable survey of the public-health importance of malaria by counties or districts we shall be able to direct our control measures to those areas in which malaria is known to be of public-health importance.

Malaria is more difficult to combat than hookworm disease. The method of diagnosing hookworm disease is easy and the method for its treatment comparatively simple. We have not yet developed a method for finding carriers of malaria that is sufficiently accurate to enable those engaged in the work to say with satisfactory exactness just who has and who has not malaria.

I sincerely trust that the investigative work, not only of the service but of all other agencies, will be conducted so that we may have for many of the problems that remain in doubt the solutions that are so urgently needed for the most intelligent carrying out of control measures throughout the infected regions.

COOPERATIVE DEMONSTRATION WORK IN RURAL SANITATION.

Dr. Lumsden addressed the conference, summarizing his remarks as follows:

1. All the discussions in this conference appear to fit into a structure comparable to Mendelejeff's table in chemistry indicating that the big need in the public-health situation in the United States is the development and maintenance of reasonably adequate whole-time local health service.

2. The results of a short-period intensive campaign for the promotion of infant hygiene, maternity hygiene, paternity hygiene, or old-age life-extension hygiene, or for the control of tuberculosis, malaria, or typhoid fever, or for the carrying out of any other special branch of health work in a community will soon be, to a large extent, lost unless there be maintained in that community a local health force to continue the work and the stimulation of popular interest in it.

3. What is a logical program of health work in one community might be absurd if applied to some other community. Therefore, the local health force with a knowledge of local conditions and a sense of relative values is needed to determine in what sequence different branches of health work may be taken up or concentrated upon to meet the local conditions.

4. Specialists in different branches of health work are needed in the field forces of the Federal health agency, the central State health agency, and the health department of the large city. From the central State or the Federal health agency specialists may be detailed temporarily to advantage to assist local health organizations in inaugurating and carrying out special branches of health work; but a plan to develop a large field force to carry out one, and one only, special branch of health work in all parts of the country (including the rural sections) would necessarily prove a disastrous failure, resulting in serious disappointment to the citizens, whose support is essential to the success of health work.

5. If local health forces were composed of variously specialized groups of workers operating independently of one another, the overhead expenses and the cost of the actual service would be too much for our average community—and certainly our rural communities generally—to bear. We should not prescribe a kind of health service which would cost more than it would be worth and which would be in fact so extravagant that we could not afford to live under such expenses for health protection.

6. Some of the plans proposed by ardent advocates and indorsed (usually without detailed understanding) by large associations of citizens, taxpayers, and voters for the establishment of specialized forces of health workers to carry on with one or another special branch of health work, though in some cases presenting a strong appeal to those who have had no practical experience in public-health work, are clearly illogical, unbusinesslike, and even preposterous.

7. One of the most important functions of a conference such as this appears to be the formulation of a definite, practical, economical, effective, businesslike, common-sense plan for the development of whole-time local health service throughout the United States, and especially in our rural communities, where reasonably adequate, well-balanced local health service is most lacking and consequently most needed.

8. The plan of rural health work in which the Public Health Service, in cooperation with State and local health agencies, has engaged—on a necessarily small scale because of the small appropriations for it—has stood the test of time and wide-range local conditions. It has proved logical, economical, and effective. It operates through a whole-time local (county or district) health officer who has the advice and counsel of experienced officials from each of the central cooperating agencies. All of the health activities in the local unit are under the immediate direction of one person and thus overhead expenses may be reduced to a minimum, travel expenses for the field force may be kept within reasonable bounds, unnecessary duplication of activities may be prevented, and the chances are at least

reasonably good for the different branches of health work needed and feasible in the community to be carried out in a logical sequence and a businesslike manner.

9. As under existing conditions of transportation and travel, health conditions in one community or State react upon health conditions in other communities or States, the establishment and maintenance of adequate local health service generally should be a matter of keen concern to all American citizens, and especially to those responsible for the direction of local, State and National governmental affairs. If Federal aid to States and State aid to local communities is justified in any field (and certainly most of us now think it is) it surely is justified in our public-health field. Any American citizen objecting to cooperation by Federal, State and local health agencies on the ground that one community or State may get a little more financial benefit out of the cooperative arrangement than another is short-sighted and needs Americanization treatment.

10. With an annual sum less than the cost of one modern battle cruiser whole-time reasonably adequate local health service could be provided in every rural community in the United States. Such an investment derived in due and reasonable proportion from Federal, State, and local governmental sources would provide to the individual, local, State, and national welfare (which is all one) a dividend yield bigger than is obtainable from any other investment of public funds.

If the members of this conference will continue persistently and consistently to avoid fads and fancies, tempting expediencies, and misguided popular sentiment, however widespread, for the development of lopsided programs of public-health work and to work for a common-sense, businesslike program for the development of well-balanced local health service, they can accomplish much of the most critical importance for our national welfare.

Dr. **Draper.** At the past two conferences, I mentioned a particular demonstration of rural public health work which is being conducted in Virginia. I will briefly describe the progress of that demonstration.

There are in the State of Virginia 100 counties. All of the counties are rural due to the fact that the cities are entirely apart and separate from the counties and pay no county taxes. In planning health work for these counties it was necessary to take into consideration the fact that in a great majority of them no health work of any kind had ever been done, except in a few instances where maybe two or three months of intensive work had been conducted in one small part of the county. Sentiment in these counties was not particularly favorable to public health work. Very few people were interested in it; very few realized the benefit to be derived; and very few believed that it was necessary.

The people were fairly well satisfied with the conditions under which they lived, and were not anxious to be disturbed. So the problem lay in finding some line of work which could be introduced into a rural community at small cost, because no large amount of money could be secured.

We did not know what the results of this demonstration would be, but we decided to employ one man to act as a sanitary officer of a county. That one man was to do the most necessary work which there happened to be in the county. In a great majority of the counties the most necessary work is that of improving sanitary conditions at the individual homes. There is in Virginia a considerable amount of typhoid fever, hookworm disease, and dysentery, also many infections with intestinal parasites. A few days ago a woman who was putting up hookworm containers at the State board of health complained of being sick. I suggested she have an examination made for intestinal parasites. A specimen was secured, and it was reported back that she was heavily infected with hookworm. An examination was also made of 53 children who came from all parts of Virginia, who were in an orphan asylum about 5 miles outside of Richmond. Out of 53 examined, 33 showed infections with intestinal parasites of one kind or another—62 per cent.

So we established in 10 of the counties of Virginia a full-time sanitary officer. In most instances he was a rather young man who had had the fundamental principles of sanitation drilled into him by experience in the counties where health work was going on. He knew the proper methods of disposing of human wastes and protecting water supplies.

We have worked in a total of 15 counties. Two of the counties were lost after one year of work. Two other counties, instead of reappropriating money for continuation of the same plan of health work, appropriated $5,000 the second year for a $10,000 unit, supported by the county, by the International Health Board, and by the State. We then secured four counties to make up for the four we had lost. There are now three counties which have made their appropriations for the third time; there are four counties which have made their appropriations for the second time; and there are three counties which are still in their first year of work.

In this plan of work the counties are asked to put up $1,500. The State board of health and the Public Health Service allot jointly $1,000, making a total county budget of $2,500. The Public Health Service also furnishes supervision—that is, an officer of the Public Health Service visits each one of these counties at regular intervals—to see that the work is conducted in a proper manner and to see that the results which the man is getting are the results intended.

At the beginning of the work we did not know just what program the sanitary officer would be able to carry out. We wanted him to do the things that were most needed. We felt that if he could secure the general installation of sanitary toilets and the protection of water supplies he would be doing well. As time went on we were able to evolve a definite program of work. Following are the "fourteen points" which constitute the platform of the sanitary officer. When we go before a board of supervisors now, we are able to say, "The sanitary officer whom we want to put in your county will adhere as far as possible to this program. These are the things he is expected to do; which we will see that he does do."

PROGRAM OF COOPERATIVE COUNTY HEALTH WORK AS CONDUCTED BY A FULL-TIME COUNTY SANITARY OFFICER.

1. Make a sanitary survey of the towns in the county; recommend such sanitary ordinances as may be necessary for placing these towns in a sanitary condition; secure passage of same by town councils; and give all possible assistance in having such ordinances put into effect and carried through to a conclusion.

The above relates principally to the passage of a sanitary privy ordinance and the installation and operation of a system for the sanitary disposal of human excreta in towns.

2. Introduce measures for the provision of sanitary closets and a safe water supply at every school in the county. Secure funds for same, supervise the work of construction, and see that it is carried to a successful conclusion.

3. Secure the installation of sanitary closets and safe water supplies at individual homes throughout the county as far as possible. (The country homes sanitated in our counties range from 500 to 1,600). This work is accomplished by education, persuasion, and voluntary cooperation on the part of the people, not by force.

4. The creation of popular interest and sentiment for public-health work to the end that the county will desire a more complete health organization the following year or, at least, continue on the same scale.

5. Cooperate with the county board of health, and act as its agent in carrying out measures for the prevention and control of communicable diseases.

6. During the winter months when conditions are such as to render outside sanitary work impracticable, the sanitary officer will give systematic talks in the schools on matters pertaining to school hygiene and public health. In this connection, he will also organize health leagues in the schools whereby each school is enabled to have a health organization composed of the pupils themselves who serve as health officers and assist the county sanitary officer in maintaining the school and its surroundings in a clean and healthful condition. The league also provides for the improvement of the individual health of its members.

These demonstrations are conducted by the State board of health and the United States Public Health Service in cooperation with the county authorities. They are best adapted to counties in which little or no public-health work has been previously carried on and in which sufficient funds to support a more nearly adequate county health organization are not available.

This plan of work requires an appropriation of $1,500 from county sources. To this original amount the State board of health will allot $1,000, making the total budget for the year $2,500. The salary of the sanitary officer ranges from $1,500 to $1,800 depending upon his qualifications and previous experience. The remainder of the budget is used for defraying the expense of automobile transportation for the sanitary officer and for necessary incidentals.

An officer of the State board of health or the United States Public Health Service is assigned to each group of four or five demonstration counties to plan and supervise the work of the sanitary officer, help him in his problems, appear before county boards and town councils in matters relating to the work, and through his knowledge and experience, assure the success of the demonstration.

As the State board of health has only a limited appropriation for cooperative county health work, the work is introduced in the counties in the order in which applications are received and as soon as practicable thereafter.

We have in several counties done additional work. We have instituted rat campaigns, in some cases catching 3,000 rats in a round-up. That has made a tremendously favorable impression upon the people. Some who were not interested before were tremendously interested by the destruction of rats. I remember that at a meeting of a board of supervisors, at which an appropriation was made for the continuation of the work a third year, one of the members said, "Doctor, I am going to vote for this appropriation. I just want to say now, while these people are here, that that rat campaign that you all carried on was worth thousands of dollars to this town. I want the people who are here to arrange for the sanitary officer to go down to their communities. I believe the number of rats which can be caught in their barns will more than pay up for the amount of expense they are put to."

Another thing that the sanitary officer can help in is the malaria work. We have one town in which, now that the typhoid situation is clarified, and the town is 100 per cent sanitary—a town of about 1,500—the malaria problem is the next most important thing. We have a trained sanitary officer who is doing malaria work now instead of typhoid. Dr. Fricks, of the Public Health Service, has a representative who goes around to see him every two or three weeks, and gives him any help that he needs. He is visiting the houses in the malaria section, telling the people the benefits which come from proper screening and the draining of mosquito breeding places right around their houses, measures which can be inexpensively carried out. The result is that these people are becoming interested. They are going to the town every week and carrying back fine mesh screening for their doors and windows.

The sanitary officer in the county also devotes some time to smallpox. We have quite a bit of smallpox. Here is where we can cooperate with the doctors in carrying on public-health work. When the county board of health has to get busy and corral its cases of smallpox, vaccinate them, and be responsible for feeding them and keeping them in quarantine it takes quite a lot of time; they are very glad to shift some of that responsibility. That is where the sanitary officer is useful. He is able to relieve the doctor of the quarantine of these cases. He sees that they get their food all right, and sometimes helps in the vaccinations.

Then when it comes time for the county to make another appropriation the doctors are willing to go before the board and give their active support to the work. Their influence is of great assistance in many instances.

We do some communicable-disease work. One of the sanitary officers was rung on the telephone the other day. Somebody said, "There is a colored woman running around here all broken out with scarlet fever. She is dangerous to this whole community. Won't you come up?" So he got hold of a doctor and went up to see this woman. He found a colored woman, terribly broken out with secondary syphilis. He immediately realized that something had to be done. He raised enough money to pay the woman's car fare down to Charlottesville, where she was treated. It happened that that colored woman was laundress for a number of the most prominent families of the town where we were working. She also came in at odd times and did cooking for people. When they discovered that this woman had secondary syphilis they were horrified; they could not believe it was so. They began to inquire into conditions, and the doctors there were kept right busy for a while making examinations of the colored help. When it came time for another appropriation to be considered people who had never been interested in sanitation or rural health work before, realized it was helping them; that the sanitary officer had gotten a woman with a dangerous disease out of the community; and that something worth while was being accomplished. They came out in large numbers and rooted for the health department and for the continuation of the sanitary health officer.

In some of the towns the work that has been done has led to the establishment of sewerage systems. One town became so enthusiastic over a sewerage system that it bonded itself so heavily it did not have enough money to support the sanitary officer another year and had to let him go.

Once a week the sanitary officer collects samples of public water supplies for examination. He also secures abatement of nuisances.

Of course, the work of the sanitary officer is very thinly scattered. He has a large area to cover, but there is a nucleus for health work; there is something to tie to. The sanitary officer has proved his use and value, so that they are willing to continue him year after year, or at least for three years, with increasing enthusiasm and interest. I do not think many of these counties have yet gotten to the point where they want to add to the sanitary officer very much, but just as soon as there is sufficient sentiment to increase the appropriation for health work, then they can do the next most important thing and gradually build up their health organization from the simple unit to a complete health organization. It may take 20 years; but as long as the nucleus is there, the building up and the development of public health work, as interest and sentiment increases, is perfectly feasible.

Dr. McCormack. I really think, from the address which Dr. Lumsden delivered to-day, if the United States Public Health Service had done no other thing in its entire existence but give him the opportunity for securing the knowledge that enabled him to make it, that would have justified its existence. I really believe that this is one of the milestones in the progress of the United States: and that if we do our duty, if we are properly charged with the ideas that he expressed here, if we have gotten the eternal fire that he has lighted here and carry it from this room into every corner of the United States, we have done the greatest day's work that has yet been done for better preventive health conditions in this whole country.

We have developed, all of us, as faddists and as specialists. We have dreamed our dream that we would free this country from one disease or some other disease. We have thought in terms of putting in each governmental unit in these United States enough different agencies so that there would be few left in any community who would not be employed by health and welfare organizations in carrying out the functions of those counties, if we carried out work to its logical conclusion.

I want to appeal to this body, and through this body to their constituents, and appeal to you to go to those constituents with this plain, practical program of work. I do not care whether you get your appropriation through a venereal-disease appropriation, through a malaria appropriation, a child-welfare appropriation, or any other one, until the people of the country have been aroused and have awakened to the importance of this work, so that money to help build up a county health department in every county where one can be built will be assured.

Let me tell you just for one moment, because I believe the recital is worth telling, of a meeting in a town the other day in a blue-grass county in Kentucky. In this county a year ago, through the cooperation of the International Health Board and the United States Public Health Service, we established a health department. It was the first time they had had one. In the meantime, owing to economic conditions, the bottom had dropped out of the income of almost any man who produced anything in that county. His products were selling for nothing; that is, things that he had raised and sent in to the centers to be manufactured had come back to him selling at the same price as during the war. They had appropriated $10,000 from their funds for continuing the health department. The county commissioners very wisely called a meeting of the citizens to determine whether the project should be continued for another year. I saw in the papers that this meeting had been called, and I drove down to it. I saw one of the most interesting and inspiring sights I have ever seen, one that can be duplicated in every county in the United States if the work is conceived and done as effectively as it had been done there. When we went into this great court room an assemblage that looked like Roosevelt and Bryan had arrived on the same day was there—1,800 of the citizens of the county, men and women. The county judge, in opening the discussion, stated very fairly what they had been called for. He gave no idea that he himself was an ardent advocate of the health department. A sharp-nosed, sharp-visaged, stoop-shouldered man got up as soon as the judge sat down.

Even our friend Dr. Nichols could not have said as many mean things in the same length of time about anybody in the world as he said about health departments. He started out by saying that health departments were conceived in iniquity and born in shame; that they were extravagant and wasteful of public funds. He told about a poor white woman whose six children were suffering from typhoid fever, and the health department had deprived her of the hogs she had been raising, with which she would have been able to pay her doctor and drug bills. He told about a child that had been quarantined for 32 days. He told about children required to be vaccinated and their parents prosecuted because they had attempted to keep them out of school when they were unvaccinated. He told about all of the incidents with considerable wealth of detail that was calculated to arouse the ignorance and appeal to the prejudices of those who knew nothing about health work. He wound up with a tirade against the venereal-disease campaign. He said he had been in the clinic and seen them there—dirty, miserable, filthy, diseased prostitutes—men and women who were rotten with disease. They were actually treating those people, when they ought to have been whipped out on the public roads and highways and driven out of the country. He made the best speech you ever heard from our standpoint on his side. Everybody in that room who had any real prejudices had them aroused and aroused right by the time he sat down.

The man who succeeded him was a round-faced, kindly looking, sandy-haired Scotch Presbyterian farmer. When he got up I felt rather like he was going to join in the same procession. He started out with the quotation that you can't remove a fool from his folly. He told of his experience in attempting to raise hogs, and the fact that he had had nine children; also he had found from actual experience that you could not raise hogs and children in the same pen economically—it oughtn't to be done as a matter of fact—that the children ran the hogs around and kept them from getting fat; every town in that county had to decide, and decide at once, which they were going to raise—children or hogs, and that there were a great many towns that ought to confine their attention to raising hogs. Those that desired to raise children ought to know that hogs and children ought not to be raised together. He said a good many other things, but he wound up by a quotation from the Sermon on the Mount—an appeal for the relief that ought to be given; that should be given; that had to be given to the poor unfortunate and ignorant.

Following his talk man after man and woman after woman from almost every section of the county rose and told in short crisp sentences of some particular thing that had been done—of a girl that had been seduced who was cared for and her baby adopted, and who was sent off to a school where she could be trained as a house servant; of a country girl whose mind had become deranged who was gotten into an institution early so that she was relieved and brought back to her sorrowing family, well; of case after case where attention, kindness, and real service had been extended by the doctors or nurses of the sanitary officer in connection with his health department. It went on for hour after hour and finally the county school superintendent, a splendid young woman, got up with a mass of papers in her hand. She stated that she had made a careful study of this proposition. That it was a matter of such tremendous importance to the people of the county that she had gone into the entire matter very carefully. She found during the year 300 children who had not been able to be in school in that county before this experiment; that the attendance in the schools of the county had been increased 33⅓ per cent during the year. She wound up by saying "in this county for the nine years before this that I have been superintendent of schools we have been maintaining a department of ill health manned by everybody in the county, where all the ignorant people in the county formed its personnel, paid for by the sick and the families of those who were diseased; supported by the wages of ignorance and sin. Are we going now to appropriate $10,000 together with the State and other appropriations for a health department that will relieve these conditions, and I want to say to you it is the cheapest money we ever spent."

She gave just one specific recital. She said a short time before two cousins contracted diphtheria, one of them in the town of Georgetown, the other in an adjoining town in another county. They came down with the disease on the same day. In one county they had a health department. The case was reported to the health officer; within an hour the family physician was notified it was diphtheria; cultures had been taken of every child in the school attended by the patient by the next morning; the house was quarantined; it was explained to the family and relatives why it should be, and they enforced it. The next morning they were notified there was no other positive culture. A Schick test was started that day of all the school children, so there will be no other cases of diphtheria develop. Over in the neighboring town there was no health officer—that is, there was a piece of one. They elected him health officer because he would serve for $25 a year. He was past the age when he could eat or digest butter and was the same as none. No report was made to him, because they knew he would do nothing. In that county they had had 31 cases of diphtheria and 11 little children had died the miserable deaths that they die from diphtheria. This beautiful woman said to them: "I want to say to you, my friends—members of my family—if ever in this county we let one child die under those circumstances I would feel, and every one of you would feel, like we had put our fingers around his little throat and choked him, and choked him until his eyes bulged. I would feel like we were murderers, you and I, and everyone of us." When she had finished, an old lawyer said: "Jedge, let us vote." But before the vote could be taken, rather a dramatic thing happened—that the first man got up, who had made the bitter attack, and said: "My friends," tears were running down his cheeks, "I was born and raised in this county; my father and grandfather and great-grandfather were; I don't think anybody in this courthouse but me ever knew what a damn fool I was. I don't propose to let you know that. I never knew what this health department was. I never had an idea these things were possible to do. I want to withdraw every statement I made." They took the vote for making the appropriation again and there was not a single, solitary man in that audience that did not stand up and vote for making the appropriation again in spite of the difficult financial condition of the county.

Before we send a special agency into any county to organize child-welfare work, venereal-disease work, school or prenatal work, or any other kind of work, it ought to be against the law until that county has shown its interest in its people enough to provide for a definite health department that will continue to carry on that work after they have left, and actually continue it. As soon as we have realized that we will stop this wastage of the people's money, we will stop this prohibitive expense centering in the capitals of our States and our Nation. As soon as great organizations, both Federal and volunteer—we largely address audiences like this that already know what we are saying—scatter it amongst our people, carry the lessons into the homes where they are needed, actually get to the people everywhere, black and white, yellow and red, and every other color—teach them all they have got to be well and strong. For God's sake don't let us do it among ourselves; let us go out and in resounding phrases make ourselves heard in every nook and corner of this great country of ours; let us arouse our people as during the war; let us make this organization reach, like the Red Cross and our Army, into every home and family in this country, so that we will come out from this thing like we were freed during the war, not from an outside enemy but from disease. Let us work and pray and pray and work, and work most of the time, and pray every now and then, and we will accomplish this purpose.

,Dr. STILES. In connection with this general argument for health departments versus specialized work, I would like to invite the attention of the meeting to the fact that while many diseases have been mentioned, one disease has been prominent by not being mentioned, i. e., amebic dysentery, to which we have not given very close attention as yet in connection with our campaign in rural sanitation and rural health work. The Public Health Service has recently been examining a large number of people to find the incidence of amebic dysentery in this country. Speaking in round numbers, you will perhaps be surprised to know that approximately 6½ per cent of the people whom we have examined in Washington, D. C., this last year are carriers of amebic dysentery. At first thought this seems very startling indeed that we should have so much latent amebic dysentery among us. We must not, however, become frightened at these figures, because from all present indications a carrier of amebic dysentery is not so dangerous a proposition as he might first appear to us. In some of our examinations we have found as high as 11 per cent carriers in an orphanage. We must in the future consider this disease more than we have considered it in the past. When we are conducting our campaign for better sanitary disposal of excreta I hope that the State health officers and the local health officers will use this additional argument, for we have a larger number of carriers of this disease in this country than we have ever suspected heretofore.

Dr. HENSHAW. The first demonstration to determine the practicability of rural health work was begun by the United States Public Health Service in one of the counties in West Virginia in 1914. The attention of the service had been attracted to the county by the large number of cases of typhoid that had occurred annually during the preceding decade—ranging in number from 135 to 249, with a mortality rate of 11 per cent.

The county and county seat had a population of 25,000, which was about equally divided. The original intention of the service was to confine its activities to the rural community, but the public health officers had scarcely begun the survey when they realized that their work was being seriously handicapped by the displeasure shown by a large per cent of the country people who regarded the survey as a particular reflection upon their habits of cleanliness, and more especially so since the county seat was without a single foot of a legitimate sewerage system and the methods of disposal of human excreta were practically the same in each. The objection of the country people was well taken, and so the plan of survey was altered to include the city as well as the country.

The demonstration was largely educational from the very beginning, and in addition to a house-to-house campaign practically every available schoolhouse was used to give talks on public health. These talks were illustrated and the lesson of sanitation of the private home was duly impressed upon the people. Before the survey not a schoolhouse and less than 1 per cent of the homes in the rural section had a sanitary privy, and the springs and other water supplies were wholly unprotected from pollution. After the survey every school and 10 per cent of the homes were equipped with sanitary privies and quite a number of the homes in the rural community installed modern improvements and conveniences, and definite steps were taken to protect nearly all of the public watering places. The city (county seat) cooperated splendidly with the work of the survey. Over 2,000 closets were cleaned; a large number of the "A" and other modern types were used to supplant the old open type; a fairly good scavenger service was begun where none had existed before; the water supply was chlorinated; and a campaign to construct an adequate sewerage system was inaugurated. The result of the survey of both city and county was highly gratifying. Instead of the high morbidity and mortality rate of typhoid that had previously prevailed the number of cases in 1915 fell to 215; in 1916, to 13; in 1917, to 6; in 1920, to 3; and two of these were from neighboring States.

The campaign for a sewerage system for the city was continued. Owing to its proximity to Washington a member of the Public Health Service frequently addressed the people upon the subject of urging the adoption of this sanitary measure. In July, 1919, a vote to issue bonds for the sole purpose of the construction of an adequate sewerage system was taken. Ninety per cent of those participating in the election declared in favor of it, and now the work is progressing as rapidly as the contracts can be let, and in order to make the city a still more desirable place in which to live, the streets are being laid with concrete and brick as fast as the sewerage program is being completed.

Ample time has now elapsed in which definite conclusions can be drawn: First, that a systematic educational program carried through the rural sections of any community will be followed immediately and permanently by marked sanitary improvements. Second, noticeable decline in the morbidity rate of infectious diseases will surely follow improved sanitary measures. Third, when a sewerage program is outlined for an incorporated city or town of any importance, followed by an active educational campaign, the program will be adopted.

Dr. DALTON. Mr. Chairman, it is rather embarrassing for a modest man to talk after all the oratory we have had. Somehow or other in Vermont we do not seem to have the wonderful things happen that they do down in Kentucky. I think I have a story to tell which I owe to the Public Health Service, because I believe in Vermont we have had the kind of a proposition which probably is unique. Several years ago when in Vermont we were laboring under the old-style system of local health officers; when we were having health-officer schools during the summer I asked Dr. Lumsden to come up and talk to our health officers on typhoid fever. He said to me, "I can not come up there; I do not know anything about your Yankee typhoid fever." Since that time Dr. Lumsden has evidently learned something about Yankee typhoid fever and Yankee conditions, because in his talk he outlined a great many things which pertain to the North—to New England. He is talking differently than he used to, when he "didn't know anything about Yankee typhoid fever."

The story is this: Dr. Lumsden told me about a year ago that the Public Health Service had decided to try to form two of these demonstration districts in New England. He asked me whether Vermont had any kind of place in which this could be done. I told him to come up and see. Eventually he did come up. He found we had there, as you all know, but he did not know at the time I believe, a system of district health officers by which the entire State is covered; whole time district health officers; all paid salaries and expenses by the State, entirely removed from local. Dr. Lumsden came up and found that we had this organization. He wondered whether his organization or plan would fit into ours. After looking it over, in a very short time I must say he decided it would and we decided to combine forces. I want to tell you what kind of conditions we had in the district which we picked out for Dr. Lumsden and he accepted. It was one of our ordinary, typical districts, rural, country people. There was no malaria at all because we do not have it. There was practically no typhoid; only the usual amount of communicable disease. There was nothing but the ordinary things which are present in the ordinary New England community. You would wonder whether that was a place for a demonstration in rural sanitation. However, Dr. Lumsden seemed to think it was. He said, "We will put in a certain amount of money here. While now the district health officer is entirely alone, has no help, we will put in an added personnel and see what can be done for demonstration." While we did not have any typhoid, malaria, or any particular amount of epidemic disease, we did have school children; we had schoolhouses; we had food establishments; more or less country hotels; we had a lot of farmhouses and meeting places of various kinds. This demonstration was started last August. The district health officer has been working very hard in this district. He has had the advantage of having with him a sanitary inspector and a health nurse. He also cooperates very successfully with the Red Cross, who furnish two or three nurses, I think, in the district; with the Tuberculosis Association, which furnished one nurse, and with other agencies. All these have been brought into cooperation.

While the demonstration period is very short, not a year, there have been results produced there which I think are worth quoting. For example, every single school child in the district has had a fairly complete physical examination during this last year. The defects have been noted; notice has been sent to the parents, and clinics have been established for the treatment of adenoids and tonsils. A great many—I can not remember just now how many—have been operated upon. We have had operating days when there were as many as 50 cases operated on at a time in a three-day clinic; 500 all told. We have two schools at the present time in which the defects that have been found in the children have all been remedied as far as possible, so that these two schools seem to be 100 per cent perfect. Now, you would think I was talking southern, but I am not. This is actually Vermont. Every schoolhouse in that district has been put into sanitary condition or will soon be. Every schoolhouse has a sanitary toilet, where, if possible, flush closets are used. The water in every schoolhouse has been examined and approved by the State board of health. Food establishments and the hotels have been examined. Several of the houses have had the sanitary toilets put in where before they used the ordinary dry closet. I do not want you to think that all of this has been done by reason of having the Public Health Service come in, because the district health officer would have done some of this work himself. As a matter of fact all our district health officers are doing some of this work. I am free to say that there has been a demonstration established in this district by reason of the added personnel, which I believe will be a stimulus to the other parts of the State, which will enable us to go to the legislature at another time and ask for more money for the other districts, so that they can be brought up on a par with this district and similar work done.

Dr. SPRAGUE. Dr. Lumsden has allowed me three minutes to tell the story of the Cape Cod health bureau, the latest cooperative rural-health demonstration fostered by the United States Public Health Service.

While telling the story I am put in mind of the Boston school marm who was summering in Vermont, and wishing to impress her hostess with the possibilities of the English language, turned to this rural sister with the inquiry, "Do your hens sit or set?" The reply was as enlightening to the school-teacher as it was unexpected, "Well, it makes very little difference to me whether they sit or set, but when they are cackling I want to know if they are laying or lying." Since we have not reached the laying stage I hesitate to cackle too loudly.

Barnstable County is Cape Cod, and with its peculiar situation is a problem all by itself. While extending about 65 miles from Buzzards Bay to Provincetown, its greatest width (excepting where joining the mainland) is scarcely more than 6 miles. This sandy, rolling, wooded cape has become an island since the completion of the "Cape Cod Canal." The permanent population is 26,670, but a quarter of a million heirs by adoption hold undisputed sway for the summer months. Veritably it is the playground of America.

For some time the town of Barnstable has been awake to the demands of the summer visitor, who no longer inquiring into the recreational attractions, demands good sanitation and clean food. Here I have found a live health department, an eleven-year-old department of milk inspection, a splendid district nursing association, and. best of all, the desire to not only see these advantages in its neighboring towns but to assist in securing them for the others. It is Barnstable that has appropriated the bulk of the funds for the work of the health bureau.

The pith of this demonstration is to show the feasibility of pooling such funds as several small towns may be able to raise for health work and thereby support an adequate health department. To the State health officer for this district belongs the credit of convincing 60 people (who control these funds in 10 towns) that this idea was not only practical, but that by so doing they were not sacrificing their right to life, liberty, and happiness by accepting the Government subsidy.

To shorten a long story, 10 towns out of 15 in the county decided to take the chance of bettering themselves, and so contributed their appropriations—allowed by the town meetings for this particular purpose, the amounts varying from $50 to $2,000, and aggregating $5,100. The United States Public Health subsidy of $2,500 is to be later equaled by the Cape Cod Chapter of the American Red Cross, this fund to be for a public-health nurse for the county, who is to work with our organization.

The voting body is composed of the members of the boards of health and school committees of the 10 towns; there is an executive committee of one member from each town, elected by the members;

and an advisory committee constituting the officers and the health officer. To give the field agent of the Public Health Service a legal standing he is appointed agent of the board of health in each town, and also school physician for each town. The department itself consists of a health officer and medical school inspector, a sanitary and milk inspector, full-time clerk, with office and equipment, and shortly a public-health nurse.

We claim nothing unique for the type of health work we are to do. In fact, if we can choose that which has proved of value elsewhere and use it to make Cape Cod healthy for its natives and an attractive resort for our summer guests, free from all the unsanitary conditions which so often abound in other summer colonies, then we shall have demonstrated an ideal method of financing and operating rural health units.

Dr. KNIGHT. In regard to specialists in public-health work, I would like to say a word about the child hygiene activities in Missouri. We blazed the way in 50 counties and 75 towns; educated the people into the belief that a full-time health officer is the thing. In two counties only we have full-time health administration under the cooperative administration of Dr. Lumsden's force. In those two counties the work has been a complete success, 100 per cent complete.

Dr. LOVE. Our health problems are quite different in certain respects from those which you have in the warmer and moister districts. We do not have malaria. We are not only 500 miles from a tree but we are 500 miles from malaria. I am glad of it from that standpoint. We have taken advantage of one point in order to protect not only the citizens of Denver and Colorado generally, but to protect our visitors, who are very many during the summer, from typhoid fever. As a matter of fact it happens that the Denver water supply has been so very remarkable for many years that we are practically free from typhoid fever the year round. It is a known fact that most of the cases which we have are cases from the surrounding districts. Some of you doubtless are already aware of the fact that we have cooperated with the Forestry Service in an effort to keep down infection and pollution of our streams in the mountains by a very simple procedure, which perhaps you can take advantage of in other districts. We have a little card which the forest rangers carry with them. You know how those fellows are riding horseback day and night all over the country. These men carry these little cards with interesting data on one side, in regard to the highest peaks, their general location, etc. Those things are always of interest to the tourist. On the other side of the card are printed those points of value from the Forest Service standpoint in regard to putting out fires and all that. This side of the card is subdivided, and also includes data in regard to the pollution of streams. That little point, it seems to me, is going to be of great value. I call attention to it because it is a little side line on the cooperative work between the State board of health and a branch of the United States service.

We also have a good deal of educational work to do in regard to the prevention of tuberculosis. That may well be taken up at a later session. I want to say that we still have to do a good deal in the way of educational work among people who go to Colorado as the result of tuberculosis.

I wish to make a motion that Dr. Lumsden be requested to collaborate with the committee on resolutions and draw up a statement to the people of the United States in regard to the necessity for the creation of a real health department that will reach to the people of the country, however remote from centers, with the lessons that mean better health, longer life, and greater happiness and usefulness to all of them.

(This motion was carried.)

COORDINATION OF EFFORT AND PROMOTION OF EFFICIENCY IN THE FIELD OF SANITARY ENGINEERING.

Dr. McLaughlin. I do not think this subject ought to be discussed now because of the fact that there is a desire on the part of most of the men to adjourn. I should like to have three minutes of your attention and then as far as this subject is concerned it can go over until to-morrow. As you know, the coordination of the engineering activities of the Federal Government and the States in relation to the control of water supplies has been in effect only a matter of about two years. About two years ago we revised the existing policy and put it upon a new basis. We were reasonably certain of our fundamentals. We put those up to this body two years ago. They put the stamp of their approval upon it. We, however, had not worked out the details of that policy, the fundamentals being these two—first, that the work of certifying water supplies be done in so far as possible by State health organizations and by no other, and that the Federal work be concentrated on developing in States which did not possess a sanitary engineering division, a strong sanitary engineering division. In other words, to avoid building up a Federal machine to do this work, which should be done by the States in their own interests; to concentrate our efforts in building up a State machine for doing this work. This has been so successful that there are now 12 sanitary engineering divisions in 12 States which did not possess them two years ago. On those two fundamentals we were clear. We stand to-day on the details of just how this procedure should be carried out. We have run into certain difficulties and certain differences of opinion as to the type of certificate we should have—one condemning and another one approving. Then we found there were certain cases that did not seem to logically belong in either category. We went ahead and made what we called a provisional certificate. This may have been a mistake—we have an open mind on the matter. However, we have got to a point now where we must have a decision by this conference as to whether it is wise or unwise.

I would ask you to appoint a committee to draw up for the advice of the Public Health Service lines of procedure in certifying water supplies, accompanied by a draft of a circular letter to put this procedure into practice—a committee of three or of five. I make that as a motion. This committee is to meet to-night, so that to-morrow we can go on with the subject. They will be ready to give us something that this conference can give out as its opinion. Tell us what your idea of procedure should be. We have only this restriction to make; it must be one policy, not two or three. We have to have one policy for all the States. We are perfectly willing to accept your dictum on just what that procedure shall be. We are perfectly willing to leave it to the committee which the Surgeon General will appoint. This is a rather important subject. At no time since the Federal Government has undertaken with the States the question of control of water in interstate traffic has the relationship between the railroad officials and the various State and Federal authorities been so cordial. There are some rather important railroad officials in town at present having meetings. I think we ought to come to some definite agreement and understanding with them within the next day or so.

(The following committee was appointed: Mr. Whittaker, of Minnesota; Mr. Horton, of New York; Dr. Boudreau, of Ohio; Mr. Emerson, of Pennsylvania; Mr. Cheswell, of West Virginia.)

Dr. Dowling. As the last thing on the program for to-morrow will be the subject of service with reference to tuberculosis, I would ask that the chair nominate a committee to confer with the resolutions committee with reference to the establishment of hospitals.

(This motion was passed.)

Dr. Parker. This morning a statement was made in regard to one of the officials of the League of Women Voters. I am the only representative of that organization here and I would like to make a statement in regard to that matter on advice which I have from Washington. Mrs. Putnam, who spoke in regard to the maternity bill, stated that the chairman of the child-welfare committee of the League of Women Voters was in the employ of the Children's Bureau.

I have here a telegram from that chairman, Mrs. D. K. Brown, daughter of the dean of Columbia University, which reads as follows: "Am not and never was employed by the Children's Bureau. Last spring and summer I collected State laws, reports of hearings, and other material which was purchased by the Children's Bureau. The indorsement of the infancy and maternity bill came a year ago last spring. Since then no connection with any Government department; have spent entire time in league work, for which no compensation has been received. Have already heard that antisuffrage workers were making this accusation to Members of the Senate. Am asking the Children's Bureau to wire ratification." The ratification from the chief of the Children's Bureau reads as follows: "Mrs. Brown has never been an employee of the Children's Bureau, but the bureau purchased certain material from her. It has had no connection with her since that time." Another statement which I wish to file a report on is in regard to the attitude of the United States Public Health Service concerning that bill. Mrs. Putnam stated that just before coming to this meeting she was approached by two members of the United States Public Health Service, who stated that they were against this bill. I am sorry that any member of the Public Health Service should have made such a statement. It contradicts the attitude of the Surgeon General himself, who in the Congressional Record is quoted as follows, at the hearing on the bill before the House on last December: "I wish the committee to distinctly understand that we are not appearing here this morning as opponents of this bill, because the United States Public Health Service, both as an organization and as individual officers, are thoroughly in sympathy with any movement looking for the improvement of the public health or any phase of it."

MORNING SESSION, JUNE 4, 1921.

The CHAIRMAN. The question now before the conference is Coordination of Effort and Promotion of Efficiency in the Field of Sanitary Engineering. This, you recall, was reached last night. A committee was appointed representing several States and the question before the house now would be as to whether the committee is ready to report or not. The question will be discussed by Dr. McLaughlin.

Dr. MCLAUGHLIN. I wonder if we realize the tremendous effect on death rates and morbidity rates of a properly equipped and smoothly functioning division of engineering. If you have ever analyzed this you will know what I mean. You will know that it means a difference in death rates from one disease alone—typhoid fever—of from about 2 or 3 deaths per 100,000, to from 50 to 100 in the States which have not such a division for controlling their water supplies.

If you would study the records of the State of Pennsylvania or of Minnesota, and follow the effect of the development of sanitary engineering divisions in these States, particularly the drop in typhoid fever rates, you would realize that no investment made by a State department of health pays bigger or more prompt returns than an investment in sanitary engineering. In the States where such a division is really controlling its water supplies, its rate from typhoid fever is probably expressed in a figure lower than 4 per 100,000. That is the reason that the service, in attempting to control the interstate water supplies, over which it has little jurisdiction, instead of attempting to build up a machine to accomplish this purpose as a Federal function, decided to concentrate its energies on divisions of sanitary engineering in States, and it found that a great many States had no division of sanitary engineering whatever; that other States had a division, so called, that was so poorly equipped that it was nothing but a division in name. So that, under the subject of Coordination of Sanitary Engineering, I want to state definitely the policies of the Public Health Service. First, all the work must be done, in so far as possible, by State agencies because it is inadvisable to build up a Federal machine to do work within a State which should be done by the State itself in its own interest. That is true in every instance, and the only excuse we have for doing such work is as a demonstration in that State to show what may be done, our work to be followed and replaced by that of the official regular agency at the earliest possible moment. Within the past two years 12 States have installed divisions of sanitary engineering and all States have improved their work in this regard. Now this work dates back nearly three years. Two years ago we got the approval of this conference on the fundamentals of this policy: (1) That all this work should be done by the State machinery in so far as that machinery could do it, and (2) that our efforts should be concentrated on the development of that machinery.

We were feeling our way and mistakes have been made, our policy probably at times being not the best policy, but it was the best we could do at the time, and this conference meeting only once a year, there was no real opportunity for getting its advice. The service looks upon this conference as an advisory council on the procedure of controlling interstate water supplies, for the reason that 90 per cent of that work must be done by the State organizations, under the constitution.

I am glad to say, Mr. Chairman, that our little discussion on just what our procedure should be has resulted in an agreement by the committee which you appointed. We will try this tentatively, and I am sure the Surgeon General will be glad to put into effect the recommendations of the committee, and if changes seem necessary next year they will be brought out at the next conference.

REPORT OF COMMITTEE OF CERTIFICATION POLICY.

Dr. **Emerson**. The committee to consider certification of water furnished common carriers engaged in interstate traffic submits the following recommendations:

That instructions heretofore issued by the Surgeon General of the United States Public Health Service relative to issuance of certificates be modified and the following procedure adopted:

First. That a certificate of approval or disapproval be issued, using a simplified form which does not include data relative to field inspection and laboratory findings appearing on the present certificate.

Treasury Department,
The Public Health Service,
Washington.

CERTIFICATE OF EXAMINATION OF WATER PROVIDED FOR COMMON CARRIERS ENGAGED IN INTERSTATE TRAFFIC.

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(Common carrier.)	(Name of watering point, including State.)

(Source and ownership of water supply.)

The available records and data from observations made indicate that this water supply is of satisfactory sanitary quality and safety and therefore the present use of the water for drinking and culinary purposes in interstate traffic is permitted.

Approved by—

Surgeon General, U. S. Public Health Service.

(Date.)

Indorsement by State health department:

(Name and title.)

(Place.)

(Date.)

Second. In order that the Surgeon General may have the necessary information regarding the various water supplies, a report form or information blank is to be furnished with the certificate for each source of supply. This information is to include a description of the supply, method of development, and findings as to quality as determined by field inspection and laboratory examinations. Such information is to be supplemented and corrected from time to time as subsequent data sheets and certificates are transmitted. This report is intended for the Surgeon General and not to be furnished the common carriers as a routine procedure.

Third. Your committee is strongly of the opinion that provisional certificates are not desirable and that no special form for such certificates should be provided. Should a State desire to qualify its indorsement a statement should be added on the face of the certificate giving the specific reasons for such qualified indorsement. On the basis of such qualified indorsement the Surgeon General may issue a provisional or qualified certificate should he deem it desirable.

The committee's discussion developed numerous reasons for a change to the form of report just recommended, which omits the record of analytical work from the certificates forwarded to the railroads. It is the Surgeon General who actually grants the permit to a railroad to use a certain water supply and the various States should therefore furnish the Surgeon General with complete information upon which to form an opinion as to the propriety of issuance of the permit. The present blank does not include sufficient data to reach a decision and we deemed it advisable to recommend use of a data sheet or report which would give the Surgeon General this necessary information, but which report would remain in the Washington office.

The question as to propriety of "provisional certificates" was discussed at length. Some States believe it desirable, while others, which have been doing the work on water supplies for interstate carriers for the longest period, are violently opposed to the suggestion. We do recognize, however, that in certain specific and isolated cases it is necessary to qualify the approval of a particular water supply. This can be accomplished through the new form by simply placing a suitable notation on the regular certificate, and at the same time furnishing the Surgeon General with the reasons for such notation. He would then be justified in issuing a qualified certificate or qualified permit to that particular railroad if he deemed it desirable and would have the complete information for so doing.

The CHAIRMAN. This is a question of great importance in every way. It is one that affects every community along the railroads of the United States and may serve as an example in other communities to stimulate the State health officials where they need stimulation in looking after water supplies. We should take the matter up and thrash it out to see exactly what we should do. I think that report of Mr. Emerson's is exceedingly valuable.

Is the State engineer of Minnesota here? Do you want to discuss this paper, Mr. Whittaker?

Mr. WHITTAKER. I'd like to make this statement: So far as the action of the committee is concerned, it seems to me that it takes care of the situation so far as all the States are involved. I refer especially to the provisional certificate. I am opposed to the provisional certificate; as far as the State of Minnesota is concerned, we believe there are only two classes of water supplies—satisfactory and unsatisfactory. Temporizing with unsafe water supplies is a dangerous practice. I think it should be left optional with the discretion of the Surgeon General if there are extraordinary cases in other States, so that some sort of a certificate can be issued.

I am also opposed to any definite form of a provisional certificate that would in any way leave it open so that an obligation could be imposed upon States opposed to such a certificate. It is rather a delicate situation, and the committee has handled it as best they could in order to give justice to all parties concerned. I think the statement concerning the provisional certificate included in the committee report is the real fundamental point at issue; the matter of the form of the certificate is a secondary matter and something on which your committee had no difficulty in reaching an agreement.

Dr. McCormack. I would like very much if it were possible for the engineering division to give us a definite statement that we can go to court with as to what is a safe water supply. It looks as if that should be possible after all the study that has been made of the subject. We are just having a remarkable experience recently in which the service is interested especially, so that I feel this is a matter that every health officer here and every engineer should know about. For a number of years a special study has been made of the Ohio River watershed and of the Ohio River water. Your engineers and our health officers and epidemiologists have made a definite study of the situation in Maysville, Ky. Analyses have been made and physical examinations of the watershed and plant have been made repeatedly, and yet, in the trial (we are attempting to abate a nuisance of the water supply at Maysville) the chairman of the board making this investigation over a number of years was unable to definitely say that the water of Maysville was polluted at all or that there was anything the matter with the water there that required remedying, but every layman who ever saw the water knows it is bad. I believe it should be possible with the scientific knowledge at hand to state in the English language in some sort of a way, a definition of polluted water, so we would know that a filthy, dirty water supply is polluted. The chairman of the board that has been investigating this water for nine years said on oath that in order to say that the water is polluted at a given point it would be necessary to have two or three or four or five specimens of the water examined at a definite time each day at different times during the day and that all those specimens would have to be taken under exactly the same conditions, that each specimen would have to be examined in the laboratory by methods with which he was personally acquainted at the time. It makes it impossible for any official to enforce any law because any such thing is impossible. I believe there should be some way to devise a practical minimum standard for public water supplies or for water supplies furnished to the public by municipalities, whether in the State or used for interstate purposes. If that could be done it would arm us with a practical weapon with which we could go before the courts and get real results.

The service of the engineering department of the Public Health Service in Kentucky has been excellent; it has done very much practical work that has laid the basis for real progress, that means better health conditions for the largest part of our population of our State. I don't believe any man in the Public Health Service has ever done any better work than Capt. Harrub and Mr. Gorman, which takes in the State of Kentucky. We now have our own sanitary engineering department. But if the service all over the country could state a minimum requirement below which water should not be used at all and could make a statement so that all of us could know when water was filthy without spending two or three million dollars on each specimen to prove it in the courts, it would be an absolute sine qua non of progress in getting rid of polluted water in our small cities and towns.

Mr. **Whittaker.** I agree with Dr. McCormack, but I think he may not realize the difficulty of fixing an absolute minimum standard for the safety of water supplies. We have certain standards we can fix, but when you get into the general subject of water supplies, it is impossible to put on paper anything elaborate enough to cover everything. I think it is a matter that finally rests with the judgment of the individual department making the investigation to use their best judgment and experience, the same as physicians would in making a diagnosis.

Dr. **McCormack.** I realize what Mr. Whittaker says, too, but there is the proposition. You come before the court and you will not convince them. They can tell whether it is polluted or not about as well as they can tell a case of smallpox or measles. It is not a matter of importance to the court unless you can go into the court and give evidence. Here is a water supply that evidence shows has had a tepidity of from 500 to 4,000 over a period of years. The Ohio River water is polluted from end to end, and yet when we go into court there is not one of the experts on the stand that is willing to swear that that water is polluted. They have written reports showing it, and they denied their own reports and said while they were warranted in making those general conclusions, they could not state that the water was polluted. When water has a tepidity of 4,000 and shows both human and animal colon infection, I want some standard to show that it is polluted when going into court.

for Boston. It was knocked out by the gentleman from the Middle West, and I have heard this morning that an appropriation of $500,000, not sufficient for New York, has been reinstated in the Senate, so we hope the port of New York will soon be equipped.

All the reports we get from Europe indicate that the sanitary conditions in central Europe are becoming more serious rather than less. Information from the Red Cross Societies the other day stated that what is probably bubonic plague has broken out in old Austria, with 33 per cent of mortality, which is quite a serious matter. Dr. Chesley, who is here now, and who came over from Poland, could tell you about conditions there.

(At this time Dr. Cbacas of the Oswaldo Cruz Institute, Peru, was introduced, and thanked the conference for his reception.)

Dr. CUMMING. I may state what will be a matter of interest to you all about the matter of the typhus situation. There was quite a serious epidemic of typhus among the Navajo Indians in New Mexico and Arizona which is supposed to have come from the Mexican border. One of the public health officers is acting as State officer in New Mexico and another in Arizona. Dr. Waller has had experience with Indians. Two medical officers have died with typhus which seemed to be a particularly virulent form. We hope the matter will be under control before long. There is some danger of its spread into Utah and Colorado.

Dr. CHESLEY. It is difficult for us here to appreciate the conditions which obtained during the typhus epidemics in eastern Europe. I had the honor to cooperate with Surg. Gen. Cumming while he was making his investigations as a member of the Inter-Allied Medical Commission. From considerable service in Poland I am very familiar with conditions there. Before the great war no such place as Poland was marked on the map. When the war began Russia, Germany, and Austria each took its quota from the Polish population for military purposes. During the first four months of the war the territory that is now Poland was overrun by armies four times. Each army, regardless of previous jurisdiction over the country, took everything it wanted for army purposes and even carried off civilians to work for the army in its own territory. After four years of such war the jurisdiction of the Germans was superseded by the Bolsheviki. The country was devastated and the people had been deprived of the ordinary necessities of life. An example which relates to the typhus situation is this; for nearly three years soap had been so scarce that few of the people had any. If one goes without soap for a week or so one appreciates that soap is rather useful and a nice thing to have around, for in a warring country if one has no soap and no extra shirt one will meet in intimate association our little friend the cootie. If cootie happens to be infected with

typhus some one may get it. Even the Surgeon General himself had the pleasure of this intimate personal contact with friend cootie. Wherever infected lice are present the typhus spreads. In a word that explains the situation over there where people have no extra shirts and no soap, in fact some have forgotten what a real bath is like.

The refugees returning to their prewar homes from all directions present a tremendous problem. Some have been prisoners of war in Siberia since 1914 or 1915. More are civilians who were driven out by the Cossacks in advance of the German invasion when the Russians burned the villages and left a devastated country with the hope that the Germans would have an experience similar to Napoleon's in the Moscow campaign. Refugees coming in from every direction, not only on the main roads but along old trails, through the swamps and forests, can not be apprehended by any line of quarantine because of lack of materials for delousing and outfitting these destitute people. Without sufficient soap and clothing the typhus barrier can be of small protection. It is not that the governments in this territory do not know how to do typhus work; probably they know better how to handle typhus than any other group of people in the world.

The Polish officer in charge of the typhus campaign, Col. Godlewski, was at the head of the sanitary division of the Austrian Army in the war. He is a man of great medical attainments, a great organizer and energetic worker, but what can he do without soap and extra clothing? Having soap, clothing, and running water, it is not difficult to handle the situation in spite of the great prejudice among a large part of the population to the removal of hirsute ornaments. The matter of these essential supplies, shirts and soap, is extremely serious and must be considered. Without such supplies the typhus campaign is certain to be a failure; with them it will be a success, and typhus is just as much an international problem at this moment as the situation in Belgium was while the Germans occupied the country. It is a menace to the whole world.

As the Surgeon General has pointed out, Congress has certain Members from the Middle West who are so far removed from the coast that they do not appreciate the importance of the Public Health Service barrier upon which the interior of the country depends for its protection against the introduction of epidemic diseases.

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Dr. **McCormack**. I dislike very much to appear so often as I am afraid you will feel I am a little dictatorial. In view of the very serious statement made by the Surgeon General and by Dr. Chesley and the statement from recognized health authorities of this country, that our ports, which constitute the one line of defense against the introduction of epidemic disease, are inadequately equipped, I move that a committee of five health officers be appointed to wait on the Secretary of the Treasury and to express to him and the heads of this Government the fact that the people of the United States have a right to expect that adequate quarantine facilities shall be furnished at all ports of entry and that all the energies of the Government shall be furnished to our Allies and others that burden this country with the introduction of disease with a view to their prevention there or here. We ought not to have typhus fever introduced into this country. Having the knowledge we should have the facilities to protect our ports of entry from the introduction of these diseases that spell disaster in the way that the invasion of the armies of Germany into Belgium and France have spelled it. We should take steps now not to alarm our people but to inform them of the dangers that confront them with a view to their prevention when there is time.

The chairman would like to announce the appointment of the following committee: Dr. Chesley, of Minnesota; Dr. Olin, of Michigan; Dr. Crumbine, of Kansas; Dr. McCormack, of Kentucky; and Dr. Dickie, of California.

Dr. **Kelley**. I am not sure that that motion was seconded, but I want to add a word on this important proposition. There has been nothing else brought out in the meetings of the official sanitary authorities of the country that has pleased me as much as the motion just made by Dr. McCormack.

For the information of some of the members of the conference and guests I might state that at the initiative of Surg. Gen. Cumming a special conference was called early in the winter of the State health authorities and municipal authorities of the principal seaports along the Atlantic seacoast. We made an effort to have incorporated into the last session of the Congress an item of the supplementary budget to enable us to increase the facilities of the ports of Boston, New York, Philadelphia, and Baltimore. It was the consensus of opinion that New York first, Boston second, and perhaps Baltimore and Philadelphia are the most serious points. We have done everything we could. His excellency, Gov. Cox, and Mayor Peters have taken the matter up actively with the Massachusetts congressional delegation. In this morning's paper, on the insistence of Senator Lodge, an item appeared stating that an item of $180,000 was inserted into the Senate bill. This is pending in the Senate.

The reason why this subject is particularly serious for this Commonwealth is because it is inevitable that whenever quarantine jams the facilities of New York, we become the natural place to get the overflow. We have a well-equipped quarantine station at Gallups Island in some respects. There is an old sterilizer there, installed in 1872, and still doing good work. It is not of the most modern, up-to-date type. The facilities for handling large groups are inadequate. One great drawback has been the lack of realization of the problem in the great Middle West and the far West. It has occurred that the chairmanships of many of the most important appropriation committees are largely held by men from the Middle and far West. I can not but feel that neither they nor their constituents are awake to the seriousness of this proposition as we are. Therefore, if the State health officers of the middle portion of the country will arouse themselves and uphold our needs, I think that would be one of the most hopeful things to be done by this conference.

I take pleasure in seconding the motion of Dr. McCormack.

(Motion carried.)

Dr. CUMMING. I have been requested to take up at this time the subject of "Basic Laws Governing Health Authorities."

BASIC LAWS GOVERNING HEALTH AUTHORITIES.

Dr. KELLEY. Before discussing briefly this topic I would like to state that owing to the pressure of business the executive committee of the State and provincial conference has a number of very important and rather difficultly worded resolutions we must take action on before we leave. We will apologize but will have to withdraw at 11.30 to consider these matters. We hope the rest of this conference will not take offense.

What I am bringing up officially was put up to me a few weeks ago merely as a suggestion by gentlemen who had given very careful thought to the subject. The point that these gentlemen had in mind is simply this. Although we are all aware of the excellent work done years ago under the immediate supervision of Dr. Kerr, of the Public Health Service, and Dr. Frankel, when a compilation was made of all the statutory laws pertaining to public health of the several States and then a compilation of the rules and regulations, it was felt that two things might be considered: (1) That that compilation, while very useful for reference, is very bulky and does not give anyone a clue as to basic principles involved; (2) it may be feasible if a special body or commission or board of the Public Health Service, perhaps in collaboration with other State officials, could secure a properly trained legal mind that was also interested in public health. If we could trace the laws of the various States and the Federal Government and put that information in a relatively short and easily comprehensible form so that in a comparatively brief manual we could have a clear-cut discussion as to wherein the basic laws enacted by the Federal Government and the States for the interest of public health touch; wherein we could show in what respects they agree and in what they differ; wherein in any important particulars our legislation has lagged behind, it would be a most valuable piece of work in proposing or trying to shape up the legislation that now exists.

I bring this before the conference by request.

Dr. Stiles. In connection with the work of the board on excreta disposal we have had to go into the laws of all the States and the ordinances of the local boards. In getting this material together we have been struck by the fact that when we publish it our report may be mistaken in some of its chapters for a special edition of Puck or Judge. Some of the public health laws of this country are most absurd. Some of them have come down to us from generations past.

It seems to me that this question of the public health laws is one of the most important ones which faces the public health situation of the country. After all, we do not need much more knowledge in public health to-day. What we need is a practical way of getting the public to utilize the knowledge which we already possess; and if we could bring that about, many of us would have to close up shop because the country would be so healthy.

It seems to me that this study of the public health laws should be made by a joint board consisting of legislators and public health officers and if possible, we should import into that board the man who wrote the public health laws of the State of Colorado. Some of them are magnificent. We should get some one in there who can define for us what is a public health nuisance—one of the most complicated questions in public health laws. I certainly hope something can be done to bring about a practical application of the suggestion that was made with a view to getting up a model State public health code, a model county public health code, and a model city public health code. That would save a tremendous amount of energy and money if it could be done.

Dr. Kelley. My main aim in closing the discussion on this subject is to bring out one point suggested. The gentleman who brought this proposition to me was convinced that owing to the difference of the fundamental conditions and different methods of units of local self-government, this very thing which Dr. Stiles suggested is impossible. We could never get a model law to be adopted. His idea was to show what the basic principles should be.

Dr. CUMMING. Problems of Interstate Health Work.—The Control of Water Supplies Used in Interstate Traffic. Will Dr. Chesley take the subject?

Dr. CHESLEY. I think all the points have been covered by Dr. McCormack and the speaker who followed him.

The CHAIRMAN. We now come to the subject of Control of the Interstate Spread of Disease. Any remarks?

Dr. McCORMACK. In the light of our present practice, I move that that heading be passed.

LEPROSY—HOSPITAL CARE IN THE UNITED STATES.

Dr. BUSBY. It is not my intention to discuss the clinical aspect of leprosy, but in a general way to present the problem of the segregation and care of leprosy by the Federal Government.

For centuries leprosy has been described in its most revolting and loathsome forms which are familiar to all of us. Unfortunate individuals suffering from this disease have been shunned and cast off by society so that the mere mention of the name causes a shudder.

Leprosy is not a local problem. It exists in various countries of the Eastern Hemisphere, and in several places large colonies have been constructed to care for these individuals. It is probable that no other physical disability requires the same kind of care. The problem is necessarily one of segregation for at least several years and possibly for the remainder of the patient's life. To the patient the outlook is most discouraging, and combined with the usual inadequate facilities for recreation, life for these unfortunates is still more unbearable. It can readily be seen that any program that does not include comfortable surroundings and proper provision for recreation and industrial pursuits is doomed to failure.

In this country the problem has been handled in the past by the individual States and practically every State at some time or other has been forced to assume guardianship of persons so afflicted. who could not be termed legal residents of that State.

This course has been necessary for the reason that a large percentage of patients afflicted with leprosy are foreign-born citizens and have developed the disease after emigrating to the Western Hemisphere. This, of course, is not true in all instances as many cases are found among native-born Americans.

In several States small colonies have been developed for the proper segregation. This has proved a very satisfactory though expensive procedure. It was frequently necessary to accept in the several State colonies patients from States where no suitable colony had been established. In other States these patients were isolated in small huts far removed from centers of population, and on numerous occasions they have eloped and presented themselves at one of the State colonies where life was more bearable. This, as you will see, increased the responsibility of the States having colonies of this character.

Congress realized that this state of affairs should not continue and that the burden should not fall upon the individual State, but upon the Government as a whole. Accordingly on February 3, 1917, Public Act No. 299 was passed providing for the care and treatment of persons afflicted with leprosy and to prevent the spread of leprosy in the United States.

Section I of this act provides that for the purpose of carrying out the provisions of this act the Secretary of the Treasury is authorized to select and obtain, by purchase or otherwise, a site suitable for the establishment of a home for the care and treatment of persons afflicted with leprosy, to be administered by the United States Public Health Service.

Section II provides that there shall be received into said home, under regulations prepared by the Surgeon General of the Public Health Service, with the approval of the Secretary of the Treasury, any person afflicted with leprosy who presents himself or herself for care, detention, and treatment, or who may be apprehended under authority of the United States quarantine acts, or any person afflicted with leprosy duly consigned to said home by the proper health authorities of any State, Territory, or the District of Columbia.

When we consider that each person suffering from this disease is potentially a ward of the Government, you can see that the future of this colony is a big undertaking. Undoubtedly there are large numbers of known cases that could be hospitalized at this colony immediately if space would permit, and there are undoubtedly numbers of persons suffering from leprosy, that are now known to the State health authorities, living in seclusion to prevent isolation and detention.

Within a short time the news will be spread broadcast that the Government has assumed the obligation for their care, and they will present themselves to the State health authorities requesting to be allowed to enter the Federal colony at Carville.

Numerous estimates have been made as to the actual number of lepers in this country. A thorough canvass is now being made of the several States, but as all reports have not yet been received, it is impossible to make an estimate at this time. It is believed, however, safe to assume that 500 beds would not be excessive for the immediate present demands of the country. Allow me to request that each State board of health make a careful survey in an attempt to secure if possible an accurate figure as to the number of patients residing in this country, in order that provision may be made for the accommodation of all these patients as speedily as possible.

In an effort to carry out the desires of Congress the Public Health Service made a careful survey of the entire country with a view of selecting a suitable site for the establishment of this colony. After many difficulties and numerous investigations it was decided that the leper colony as established by the State of Louisiana at Carville would be the most suitable place for this home. Therefore on January 3, 1921, the Public Health Service was advised that the title to the property had been transferred and possession could be had after that date.

This tract of land is situated along the banks of the Mississippi River, 80 miles from New Orleans and 16 miles from Baton Rouge. It is needless to say that the capacity of this colony was quite limited, as it was the intent of the State of Louisiana to hospitalize at this point only those falling under the jurisdiction of the State itself.

It was necessary to accept as wards of the Government such patients as were then confined at this colony, numbering 88. At the time of transfer of this property the total bed capacity was approximately 90. By making several minor changes it was possible to increase this capacity to 111, and this additional space was quickly filled by patients from other States. At this time Dr. Oswald Denney, who has had a number of years of very valuable experience at the Culion leper colony in the Philippines, was assigned as medical officer in charge of the reservation.

Before the transfer of the property to Federal jurisdiction was effected tentative plans had been drawn for the utilization of the remainder of the appropriation in excess of the purchase price for new construction. These plans have been completed and new construction will begin in a short time. It is hoped that in possibly four or five months the service will be able to accommodate approximately 70 additional patients. When we consider that the problem is not essentially one of hospitalization, but one of providing a suitable place for the patients to spend perhaps the remainder of their lives, it can be readily seen that it is desirable and, in fact, essential that every effort be made to provide pleasing surroundings, and to this end cottages should be so furnished and equipped as to render their detention least depressing. These patients do not require strictly hospital care and in the majority of cases are able to follow some form of vocational endeavor.

The houses in a colony of this kind are necessarily of the cottage type, and it is desirable that provision be made for each patient to have a separate room.

Construction of this character is, of course, much more expensive to build and administer than the ordinary type of hospital construction.

In a careful analysis of the problem, it has been found that the appropriation of 1917 will be entirely inadequate to care for even the known cases now in this country. It will be necessary to go before Congress and present the problem as it now exists and ask for additional appropriation to complete the present plans and make the necessary additions to accommodate the patients now in the several States. It will further be necessary for a number of the States to continue the care of these patients until such time as accommodations are available at Carville. The Public Health Service is only too anxious to assume this obligation, and an effort will be made for an additional appropriation to allow the extension of facilities so that each State may be relieved of its burden at the earliest possible moment.

As stated above, this type of construction is more expensive than ordinary construction, and it is believed that it will require one and one-half million dollars to properly equip this institution and provide sufficient accommodations for the lepers now in this country.

Section II of public act No. 299 provides that the Surgeon General of the Public Health Service is authorized, upon request of said authorities, to send for any person afflicted with leprosy within their respective jurisdictions, and to convey said person to such home for detention and treatment, and when the transportation of any such person is undertaken for the protection of the public health, the expense of such removal shall be paid from funds set aside for the maintenance of said home.

This, as you will see, allows the Public Health Service to assume the obligation of transfer of any leper from any State to Carville, La. It is needless to say that the problem of transportation has in the past, and in all probability will in the future, cause considerable concern, not because it is more dangerous to transport a case of leprosy than a case of tuberculosis but because the public demands that extreme precaution be taken in the transfer of each patient so afflicted.

Every effort should be made to guard against the possibility of transferring a patient to this colony in which a definite diagnosis of leprosy has not been established. It will be necessary in each instance that the State board of health verify the diagnosis.

In making request upon the Surgeon General of the Public Health Service for transfer to the Federal colony, it will be necessary that the name of the patient be given in full, also age, sex, color, home address, address of nearest relative, nativity, length of time in United

States, date of appearance of symptoms, manifestations, type of disease, and length of time under observation. It should also be stated upon the request for transfer that the diagnosis was confirmed by clinical and bacteriological examinations or histologic findings, and the transfer will not be authorized except through the State boards of health of the several States. A plea is again made that State boards of health carefully guard against the transfer of any patient unless a positive diagnosis of leprosy can be established.

It is suggested that when a case comes under the observation of any State board of health, and a positive diagnosis can not be made, that the usual smears and histologic sections be forwarded to the Hygienic Laboratory of the Public Health Service, Washington, D. C., and careful detailed history, with report of examination of the case. Every effort will be made to assist the State board of health in arriving at a definite diagnosis.

In closing I wish to state that at some time in the future provisions will be made in which cases that are doubtful might be observed for a sufficient period of time to establish a definite diagnosis, and further that space will allow for the proper detention of all contacts until such a time as a negative diagnosis has been determined.

Dr. Dowling. You have heard the paper just read. In Louisiana we are in an embarrassing position. The leprosarium has been taken over by the Federal Government; its capacity is exhausted; an act of the legislature requires that when lepers are detected they shall be transferred to the leper home. The other day, after I had told the newspapers of Dr. Denny's request that no more patients be sent to the home, a health officer telephoned and asked what he should do. I replied that neither he nor I had any discretion in the matter.

I shall be glad to have you recommend what we shall advise under these circumstances. I am in full sympathy with you and I realize the situation; on the other hand, you will appreciate the position in which we are placed.

I hope it will be possible for you to erect temporary quarters where these patients can be cared for. Before the leprosarium had been transferred the State of Louisiana spent about $60,000 in maintaining the home since it was acquired.

We understand, unofficially, that there are a number of cases in different sections of the State which have not been reported, but may be at any time.

The Chairman. It might be of some interest to ask Dr. Scherechewsky to describe what progress has been made in the care of lepers and what the service has been trying out in the treatment of lepers.

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ment is 3 years and 3 months, and the shortest period has been 9 or 10 months. It is a little bit early to make a definite statement.

We have started the treatment at Carville. They don't give us such encouraging reports from there as we have from Hawaii. It may be that the strain of leprosy in the Hawaiian Islands is more amenable to treatment than the one in this country.

Incipient lepers in Hawaii declare themselves because they have seen so many of their associates return to civil life. In Hawaii we get a large number of favorable cases for treatment, but in the United States they conceal themselves from the health authorities. Many of the cases we have at Carville are of many years' standing and are extremely chronic. What we find is this, that these derivatives of chaulmoogra oil furnish very valuable means of treatment for leprosy and arresting it in favorable cases. Where the disease has been chronic for many years we must not expect such favorable results. In incipient leprosy they will declare themselves so they may have removed from them the stigma of the disease. In that way we have the favorable cases for treatment. We may possibly find in the future, instead of a national leprosarium becoming a life domicile, it will be on a par with institutions like tuberculosis institutions, which will receive cases, treat them and restore them before long to citizenship.

Dr. HURTY. During my experience as health commissioner of Indiana I have had to deal with five lepers. All five were accidentally discovered and all had consulted from 10 to 15 doctors that never for a moment suspected they had leprosy. The last case (we have him at the present time) was a soldier in the Philippine Islands. After he had been there some months he contracted what they told him was sprew dysentery. He was sent home in a hospital ship and taken care of in a military hospital somewhere in the Northwest. He told us since, he commenced to develop anesthetic areas 16 or 18 years ago. He found his feet and hands were numb. He was discovered accidentally at Indianapolis while making a jack-o'-lantern for a child that he and his wife had adopted. The jack-o'-lantern had a candle in it and thoughtlessly he put his hand over the candle. It burned away a portion of his left hand so that the little finger had to be amputated. He did not know it was being burned until the little girl called his attention to it. He went to see a physician who was not impressed with the story and demonstration of the anesthetic condition and failed to note its significance. That physician left the city and our leper had to consult another. The next man was a Norwegian who had seen cases of leprosy. The leper told him how he burned his hand and had the finger amputated, and the wound was not doing well, so the physician told him then that he suspected he had leprosy. He was a graduate of medicine in Norway. You see how accidental it was that this leper was discovered. He had also some ulcers on his arm and back, and had several anesthetic areas and it was easy to demonstrate the presence of the bacillus of leprosy.

We have this leper on hand now and we can confirm what Dr. Scherechewsky said about treatment with the derivatives of chaulmoogra oil. His anesthetic areas are fading away. I forgot to mention that his mouth was very sore but this symptom is now almost gone under chaulmoogra treatment. His anesthetic areas are diminishing and the ugly ulcer on the left arm has healed up nicely. The man has increased in weight 20 pounds. Of course, he is doing nothing; he is under quarantine in the southern edge of Indianapolis in a little house. He must have been suffering from leprosy for years, for he noticed the anesthetic areas 18 years ago.

The fact that all of our Indiana lepers were discovered by accident would lead one to believe there are more in the State. How many lepers are there walking around Indiana or other States who may have been soldiers in the Philippines?

We had another leper on whom we did not have a chance to try the ethyl ester. He is dead. He came from Panama, more than 20 physicians had examined him, but the disease was detected by an undergraduate in our medical college. He had never seen a case of leprosy but had been studying it in the books. When he saw the man being examined by the clinician, he came forward and said "May I look at it?" The privilege was accorded and in a few moments he remarked, "My guess is that this is leprosy," and he was right. Is it not possible that we have lots of lepers walking about the streets to-day and we know nothing about it?

We were quite sorry we could not find quarters for our leper in Carville but he is getting along so nicely now that it may be quite as well. He now shows no outward evidence of leprosy except slight anesthetic areas. His ulcers are all healed, his mouth seems to be cured and he is increasing in weight, but still we get the leprosy bacillus from the mucosa of the septum.

The CHAIRMAN. We are doing all we can under the law to expedite the completion of the hospital in Carville. We have nothing to do with the construction of public buildings. They are built by other branches of the Government and turned over to us. We can look far enough ahead to see the necessity for another leprosarium and as soon as the necessity for economy passes by we probably shall ask for one for the Pacific coast.

I have been asked to take up, out of order, the report of the committee on resolutions. I will ask Dr. Dickie of California to make the report.

Dr. DICKIE. Report of committee on resolutions read.

(It was moved and seconded that the resolutions read by Dr. Dickie, relative to rural health, etc., be adopted. Motion carried.)

The resolutions are as follows:

Whereas (1) less than 5 per cent of the rural population of the United States is now provided with local whole-time health service approaching adequacy; and

Whereas (2) the lack of health service in our rural districts—which are the sources of our food, clothing, and fuel supplies—is a serious detriment to the welfare of our whole population, rural and urban; and

Whereas (3) insanitary conditions and unreported and uncontrolled communicable disease in one section are, under modern conditions of transportation and travel, a menace to all other sections of this country; and

Whereas (4) the strength of our united Nation to meet the crises of either war time or peace time depends upon the vigor not of a part but of our whole population; and

Whereas (5) the conservation and promotion of the national health is the most important single item in the program of national welfare with which the individual citizen is concerned and for the promotion of which our Government, local, State, and Federal, has been created and is maintained; and

Whereas (6) the development in our rural districts of reasonably adequate health service to meet the serious needs of the situation is not being and can not be expected to be accomplished at a satisfactory rate without proper support by the Federal and the State Governments; and

Whereas (7) the health needs of different localities, varying widely because of differences in climatic, economic, social and other conditions, can not be met economically and effectively by any highly specialized program of health work; Therefore be it

Resolved by the conference of State and Territorial health officers with the Public Health Service:

(1) That proper expenditures for the establishment and maintenance throughout our rural districts of local health service with whole-time, well-qualified personnel to carry out in logical and advantageous sequence the different branches of health work needed from time to time in the different localities would accomplish more for the national welfare than could be accomplished with equivalent expenditures for any other purpose;

(2) That the application of the principle of Federal aid extension to rural health promotion is entirely logical, is consistent with the theory and established practices of our system of government and is necessary to the protection, to a reasonable degree, of our national health interests;

(3) That the cooperation of the Federal Government with State and local agencies for the promotion of rural health work should be extended through one Federal health agency in one department of the Federal Government;

(4) That of the sum of about $20,000,000 a year which eventually will be needed to carry out a reasonably adequate program of rural health work in the United States, about $2,000,000 should be furnished by the Federal Government, about $6,000,000 by State governments, and about $12,000,000 by local (county, township, or town) governments with the financial assistance of private agencies;

(5) That copies of these resolutions be sent at once to the Secretary of the Treasury and to the respective chairmen of the appropriation committees, the Committee on Industrial and Foreign Commerce in the House, and the Com-

in public health. If we could trace the laws of the various States and the Federal Government and put that information in a relatively short and easily comprehensible form so that in a comparatively brief manual we could have a clear-cut discussion as to wherein the basic laws enacted by the Federal Government and the States for the interest of public health touch; wherein we could show in what respects they agree and in what they differ; wherein in any important particulars our legislation has lagged behind, it would be a most valuable piece of work in proposing or trying to shape up the legislation that now exists.

I bring this before the conference by request.

Dr. Stiles. In connection with the work of the board on excreta disposal we have had to go into the laws of all the States and the ordinances of the local boards. In getting this material together we have been struck by the fact that when we publish it our report may be mistaken in some of its chapters for a special edition of Puck or Judge. Some of the public health laws of this country are most absurd. Some of them have come down to us from generations past.

It seems to me that this question of the public health laws is one of the most important ones which faces the public health situation of the country. After all, we do not need much more knowledge in public health to-day. What we need is a practical way of getting the public to utilize the knowledge which we already possess; and if we could bring that about, many of us would have to close up shop because the country would be so healthy.

It seems to me that this study of the public health laws should be made by a joint board consisting of legislators and public health officers and if possible, we should import into that board the man who wrote the public health laws of the State of Colorado. Some of them are magnificent. We should get some one in there who can define for us what is a public health nuisance—one of the most complicated questions in public health laws. I certainly hope something can be done to bring about a practical application of the suggestion that was made with a view to getting up a model State public health code, a model county public health code, and a model city public health code. That would save a tremendous amount of energy and money if it could be done.

Dr. Kelley. My main aim in closing the discussion on this subject is to bring out one point suggested. The gentleman who brought this proposition to me was convinced that owing to the difference of the fundamental conditions and different methods of units of local self-government, this very thing which Dr. Stiles suggested is impossible. We could never get a model law to be adopted. His idea was to show what the basic principles should be.

Dr. CUMMING. Problems of Interstate Health Work.—The Control of Water Supplies Used in Interstate Traffic. Will Dr. Chesley take the subject?

Dr. CHESLEY. I think all the points have been covered by Dr. McCormack and the speaker who followed him.

The CHAIRMAN. We now come to the subject of Control of the Interstate Spread of Disease. Any remarks?

Dr. McCORMACK. In the light of our present practice, I move that that heading be passed.

LEPROSY—HOSPITAL CARE IN THE UNITED STATES.

Dr. BUSBY. It is not my intention to discuss the clinical aspect of leprosy, but in a general way to present the problem of the segregation and care of leprosy by the Federal Government.

For centuries leprosy has been described in its most revolting and loathsome forms which are familiar to all of us. Unfortunate individuals suffering from this disease have been shunned and cast off by society so that the mere mention of the name causes a shudder.

Leprosy is not a local problem. It exists in various countries of the Eastern Hemisphere, and in several places large colonies have been constructed to care for these individuals. It is probable that no other physical disability requires the same kind of care. The problem is necessarily one of segregation for at least several years and possibly for the remainder of the patient's life. To the patient the outlook is most discouraging, and combined with the usual inadequate facilities for recreation, life for these unfortunates is still more unbearable. It can readily be seen that any program that does not include comfortable surroundings and proper provision for recreation and industrial pursuits is doomed to failure.

In this country the problem has been handled in the past by the individual States and practically every State at some time or other has been forced to assume guardianship of persons so afflicted. who could not be termed legal residents of that State.

This course has been necessary for the reason that a large percentage of patients afflicted with leprosy are foreign-born citizens and have developed the disease after emigrating to the Western Hemisphere. This, of course, is not true in all instances as many cases are found among native-born Americans.

In several States small colonies have been developed for the proper segregation. This has proved a very satisfactory though expensive procedure. It was frequently necessary to accept in the several State colonies patients from States where no suitable colony had been established. In other States these patients were isolated in small huts far removed from centers of population, and on numerous ocdiately preceding or immediately following the meeting in New York it would interfere with the attendance at the Public Health Association meeting or that it would interfere with the institute attendance at Washington. It was suggested that we hold the institute in New York City either before or after the Public Health Association meeting. This is impracticable from an administrative and economic standpoint. It cost so much more to hold an institute in New York that we decided we could not hold it there. If the American Public Health Association feels that holding the institute in Washington is going to interfere with the attendance at the jubilee meeting, we will postpone it. I discussed this matter with two members of the executive committee of the association and they suggested that we get the opinion of the State health officers on this question. I would like to ask that you express an opinion on this question.

The Surgeon General. I would suggest that we defer action on this matter, if it meets with your approval, since many of the State health officers on the committee which is now out are also prominent officials in the Public Health Association. What Dr. Pierce is telling you is that the service first initiated the idea of the institute, but we don't want to interfere with the success of the fiftieth anniversary of the American Public Health Association. We have had some discussion and we are willing to postpone our institute entirely or do what would be best. Dr. Pierce suggested that we might have a preliminary meeting in Washington, to discuss the Public Health Service cooperation with the American Public Health Association to make their annual meeting a great success.

Dr. Pierce. Those men who are now out of the room are familiar with the proposition. This afternoon I will ask the Surgeon General to put the motion to you.

SUGGESTIONS FOR FUTURE WORK IN VENEREAL DISEASE CONTROL.

Dr. Pierce. I am going to make a very brief statement of the problem as I see it, of conducting venereal disease-control work in the United States. It is not necessary for me to go into details of the status of the matter at the present time. You men are as familiar with the subject as I am. During the past three years we have demonstrated the practicability of a particular plan whereby each State board of health has a bureau or some organization in their State board of health for venereal disease control, the Public Health Service cooperating with the State in certain respects.

Yesterday when Dr. Lumsden and Dr. McCormack were speaking of the necessity for establishing local health units, I regretted that I could not introduce some of the oratory they used into this talk for to-day, and to say that with the establishment of local health units, a full program, including venereal disease control, should be undertaken by each State board of health. To make venereal disease control a part of the work of State boards of health and the health work of the communities and the cities, it must be incorporated in those local health units that are formed. Venereal disease, like all other diseases, is a local health problem and we should impress upon the smaller divisions of the State the necessity for raising local funds to meet local expenses. There is also a State relationship to the problem. Venereal disease can in no way be regarded as a sectional disease; we have it all over the United States and in all classes of people. There is also a very definite national relationship to the problem. One reason for Federal responsibility is the fact that a very large number of persons who are a great menace to the various communities travel from one State to another. Therefore, the Federal Government has a definite responsibility for the care of those who are making themselves a menace to the various States. Under the interstate quarantine amendment, referring to the travel of persons infected with venereal disease, we have secured six convictions in the Federal court. The validity of the law has been thereby established.

I would like also to point out the fact that when one is convicted in a Federal court, the one serving the sentence becomes a ward of the Federal Government and is sent to a suitable place for detention. In these instances the persons convicted were sent to a home in Iowa, although the convictions were secured in Arkansas. Such work is an instance of the relationship of the Federal Government to the program.

Information regarding the health problems of the United States is very helpful not only to the Public Health Service but in stimulating interest in the local communities. It would be folly for us to advocate specializing in venereal-disease control or carrying on a plan in a State which did not recognize the various methods and influences which can be used to solve the venereal-disease problem. Undoubtedly the medical measures are absolutely essential and highly important because the quicker we terminate the period of infectiousness the less likely is one to spread the disease to others. It would not be adequate if we concentrated on purely the medical program calling for the treatment of the infected person. It is more important and desirable to prevent persons who are not infected from acquiring infections. To do that we must carry on educational work and preventive work which has been called law enforcement, and is included in the general term protective social measures. Every State has its duty in carrying out the medical, educational, and legal phases of this program.

The question of law enforcement has been the stumbling block in many States because many State boards of health feel they are not the law-enforcing agency. The question of enforcing certain laws which have for their object eliminating the danger of exposing persons to communicable disease is the province of the State board of health, in that they should secure and make available the sort of aid needed by the law-enforcing agencies to eliminate houses of prostitution and other ways whereby prostitutes expose persons to venereal infection.

In developing the work of the States I would like to suggest that all of us realize the importance of public opinion because we can not carry on any program of education, nor can we secure attendance at clinics, unless the people of the community understand what the object of the treatment is, and what the State board of health is trying to accomplish. In carrying this work to the cities and communities of each State it is important for us to secure the interest of influential business men, chambers of commerce, and the social organizations such as rotary and other clubs and through them develop public opinion in the cities so that when you ask for appropriations from the State legislature many of the legislators will be familiar with the problem and the reasons for raising funds for the work.

The Public Health Service has found it helpful to form contacts with national associations of women. We have a women's advisory council, on which 15 of the women's organizations are represented. We have planned to suggest to the State health officers the holding of institutes in local communities throughout the State whereby a close relationship can be maintained between the State board of health and the organized women throughout the country. I have for distribution a suggested program for such meetings which is subject to whatever modification may be found to be necessary in each particular State. It is needless to say that the Public Health Service is not going to hold any institute in your State until we have previously discussed the advisability with the health officers and secured your approval. If you would like to take one of these programs and look it over and send it to the Public Health Service with any suggestions or criticisms we would appreciate it. This will be sent to you by mail later on and reference made to the fact that it was brought up at this meeting for discussion.

I have made no reference to the source of revenue for continuing this work. At present there are three items in the second deficiency bill which, I am told, passed the Senate and went to the House for adoption, providing for an appropriation of $200,000 for State boards of health, beginning July 1. It is important for all State boards of health to maintain their present work in view of the fact that you will receive very little financial help from the Federal Government during the present year. I understand that the State health officers have already expressed their opinion on this matter by sending telegrams to the House and Senate Appropriations Committees last night, so no further comment is necessary from me. Next year, when you are asking your State legislators for appropriations for continuing venereal-disease control work, it would be highly desirable to leave out any reference to the small appropriation to be received from the Federal Government. At present 11 States have a contingency clause which makes unavailable for their own use State appropriations, unless they receive a similar sum from the Federal Government.

We should keep in mind that all of us should keep up the work to the very utmost extent possible under State appropriation; that we should realize the necessity of creating public opinion in favor of continuing the program; that we incorporate venereal disease control work as a part of local health unit work; and that we get the State appropriations in such a manner as not to be hampered by the failure of the Federal Government to support the work by allotment of funds.

The two subtopics under this subject were introduced by a State health officer and it was our opinion that he wished to discuss these two items himself. However, I am going to take the liberty of expressing my opinion on these questions. (1) I have no doubt at all about the proper agency for the control of venereal disease. It is the health authorities of the State and local communities. The problem is one that every State board of health should realize belongs to them primarily, that they can count on some assistance from the Federal Government, but that primarily it is their problem and it should be passed back through these local health units on to the community directly affected. The second question also seems to me not subject to discussion, except to this extent, that any lay activity relating to any health problem in any State or community should be carried on only in accordance with the counsel and advice and guidance of the local health authority. There is no doubt but that a great deal of lost energy has resulted from all sorts of volunteer agencies carrying on unsupervised programs for various related health topics. All of these agencies could simplify methods of administration if all would take up with the State health officer or city health officer just what they propose to do in a community. This would avoid a great deal of confusion and overlapping of energy and duplication of work and would stimulate the whole program for promoting the public health of the United States. With regard to these last two topics, I am merely expressing my personal opinion in the matter. If the State health officer who proposed these questions would like to report on the subject I hope he will do so.

I would like to leave this thought with you: Whatever happens to our appropriations, and we hope they will be passed by the House and Senate in order to keep up our relationship through the extension of Federal financial aid; we do not want to be depressed nor lose the interest of the public in venereal-disease control measures in the various States. Nevada recently established a venereal disease control bureau. The District of Columbia is the only area not actively engaged in venereal-disease control. I can not conceive how the loss of a few hundred thousand dollars from Congress is going to destroy a great organization which has the support of every thinking man and woman of the United States. It is extremely encouraging to all of us associated with this work to know we have behind venereal-disease control the unqualified support of the best people of the country.

Dr. SCHERESCHEWSKY. Dr. Pierce's remarks are now open for discussion.

Dr. TURNER. Were it not for the lateness of the hour, I should like to report on the two items which I suggested for discussion. On account of the fact that there is so much still to come before the conference, I believe it would be selfish on my part to introduce any discussion on these topics. What time may be allotted to the subject of venereal disease should be in discussion of the facts that were so well presented by Dr. Pierce.

In the State of Washington we have special problems. The relation of the lay activities to our work is in such a way that it creates perhaps more of a special problem than in other States. Our own viewpoint in the health department directly coincides with the opinion expressed by Dr. Pierce, that all the activities should be controlled directly by the department and, as we used to say in the Army, everything going through channels. I believe that is the ultimate way, together with the help of the Federal authorities through the Public Health Service, whereby venereal-disease control may be had. I don't think any of us should forget that venereal disease is bound to stay and it has got to be controlled. As it is an interstate disease and a national problem, such regulations as are made should be of uniform character, and should have one object in view, that is, universal method of control. By having a unified way of control and treatment of venereal disease, I believe that the ultimate object of control and prevention and cure will be derived.

Dr. THEEBERG. Dr. Jones said many years ago that the one object of education would be to give a person enough knowledge of science to enable him to distinguish between a doctor and a quack. That has been one of the objects of my existence for the last 34 years, to give that knowledge to some thousands of American young women at the institution with which I have been connected—Vassar College.

I feel that the issuing of policies and the support of the American Public Health Association has been of inestimable advantage to me in my teaching, and I have felt a very great obligation to the Surgeon General and Dr. Pierce in asking me to attend this meeting. I have seldom been more benefited than has been the case in the last two days. I thank you very much for the privilege of being here and I have enjoyed immensely the contact with the minds of this gathering. Not only do I feel that what I have gained will benefit my teaching but I feel it will benefit the various women's organizations with which I am in contact, for instance, the position which I hold as chairman of Public Health of the American Council of Women, and by that I enjoy the privilege of sitting with the chairmen of the National Councils of Public Health and the National Councils of Women of 26 nations. I enjoyed that privilege last year in Christiania and I presented to that council of women in detail the work of the American Public Health Association and notably the Public Health Service of the United States.

No other nation is doing anything in this matter of control of venereal disease, and they were especially interested and benefited by the weekly reports of the legislative procedure which I was enabled to take to them and show them for their guidance and I hope, to some extent, for their example.

I will tell you of one of my pupils, Dr. Baker, who has been in charge of the children's bureau of New York City during nine administrations. I doubt if any public officer of the New York City administration has sustained herself through so many administrations as that. Dr. Baker said not long ago that she sometimes felt in relation to her career like the old darky woman who was asked to ride on the merry-go-round and said " You pay 5 cents and they whirl you around and whirl you around, and after they gét all your money, where you been? "

I believe if you would avail yourselves of the educated, intelligent women, such as Dr. Josephine Baker, in this matter of public health, it would be of very great benefit to the country and very great interest to yourselves.

Dr. Fowler. Dr. Pierce referred to the District of Columbia as having no active work in venereal disease control. I feel I want to place the people of the District of Columbia in the proper position. We have, as Dr. Pierce stated, no law for the control of venereal disease. It is the capital city of the nation and the only place in the United States that has no law on the subject. You may know that all of the laws of the District of Columbia are enacted by the Congress of the United States. We do not have any legislature, city councils, or similar body, and we are dependent upon the acts of Congress. Efforts have been made during the past three years to secure the enactment of laws similar to those in other States, but up to the present time without success. I want to say to you that Congressmen and Senators of the United States are not together on this law. I know that some do not favor it. Recently one of the members of the District Committee of the Senate with whom I was discussing this question expressed disapproval of important points in the proposed legislation, but I said to him "Senator, your own State has enacted legislation similar to this and I don't see how you could help favoring it for the District of Columbia." I handed him a copy of his own State law, with which he was apparently unfamiliar. I mention this to show you that it is not the citizens of the District of Columbia who are opposed to it, but there seems to be a disinclination on the part of the Congress to legislate along this line for the District of Columbia.

Dr. Hurty moved that the meeting adjourn until 2 o'clock, at which time the subject of child hygiene be taken up promptly.

Motion seconded. Carried and meeting adjourned to 2 o'clock.

Announcement made that Dr. Mary Riggs Noble, assistant chief of the division of child welfare, representing the department of health of Pennsylvania, was present to represent Dr. Edward Martin, commissioner of health.

AFTERNOON SESSION, JUNE 4, 1921.

The CHAIRMAN. At the morning meeting Dr. Pierce brought up for discussion an expression of opinion on your part of the practicability of having a health institute of the service in Washington immediately preceding the fiftieth anniversary meeting of the American Public Health Association in New York City, or immediately following it. I would like to ask Dr. Olin to tell us what he thinks about it.

Dr. OLIN. Of course, it goes without saying that the State health officers will approve of such a plan, but I believe there is hardly a State in the Union whose legislature this year has not decided to enforce strict economy. I can only speak for Michigan and it would be absolutely impossible for me or any of my staff to attend such a school. If the school is held, of course, I would, of necessity, have to refuse to allow any of my staff to go even were their expenses paid, or if they decided to pay their own expenses if they have taken their vacation, because I was censored for allowing so many of my staff to attend the Washington meetings last year. It takes too many out of the organization in the State. I feel that the majority of the executives feel the same as I do, that it would be a financial impossibility for us to allow our members to attend at this school.

The CHAIRMAN. Any other questions?

Dr. McCormack. If arrangements could be made to have substitutes for our staffs while they are away and their expenses and salaries paid, it would be different, but I think that is probably as impracticable as to get the State legislature to send the entire staff to the institute.

Dr. McLaughlin. I would like to ask Dr. Olin if it would be any easier for his staff to get away next year, or if any of his staff will attend the American Public Health Association meeting in New York.

Dr. Olin. I doubt if any of my staff will attend the Public Health Association meeting in New York. I shall try to go myself, but I doubt if any of my staff can attend it.

The Chairman. We might get the opinion of the health officers of the conference by making this in the form of a motion. Will those of you who feel it would not be feasible or practicable to hold an institute immediately preceding the meeting of the Public Health Association please signify by saying "aye"? (Majority in favor of not holding the institute.)

It is equally impossible for us to have the institute in New York with the American Public Health Association because the Federal funds are also somewhat limited and I don't feel we could send the officers up there at that time.

The subject before the conference now is Child Hygiene.

CHILD HYGIENE.

Dr. Clark. Mr. Chairman, ladies, and gentlemen, I feel we have arrived at the consideration of the most important topic presented at this conference. Realizing as I do that child hygiene involves consideration of every cycle of life, that it requires inquiry into every phase of public health and sanitation, that it stands in most intimate relation to every public-health problem confronting the health officer, that it touches on probably every activity of State government, it would be perfectly hopeless for me to attempt to outline it to you in the brief time allotted to the subject, or to try to emphasize the importance of child hygiene from the standpoint of the public-health officer. I think my time had best be devoted to refuting the statement that has been made in certain circles that the Public Health Service has done very little in child hygiene and in outlining to you briefly what we have attempted to accomplish in the past year.

You must remember that we who are in the Federal Health Department suffer from the limitations of lack of funds as you gentlemen from the State health organizations do. Our work, by reason of the nature of our appropriation, must, of necessity, be limited to investigation and be carried on by the division of scientific research in the form of investigation. We have participated in demonstrations. These demonstrations have been made, as I believe all demonstrations should be made, at the instance of the State or local health authorities. We have simply participated in the way of supplying trained workers to help the State health organization to put across its child-hygiene program, while studying child-health organization and administration, with a view to standardizing the work. We have continued during the year the uncompleted work of last year, which was reported in part at the last meeting of the State and Territorial health officers with the Public Health Service. We have continued the work in Missouri and have about completed a very wonderful piece of work, not so much because of the number of local child-health organizations that have been effected as on account of the creation of a State-wide feeling in favor of legislative appropriations for this form of work. If you realize that Missouri is a State not in the birth-registration area, a State that appropriated so little money for health work that the State health officer has to pay his own expenses when he attends conferences of this character, a State that had established a division of child hygiene and gave no money for its maintenance and operation, you can realize what we had to do. Largely as the result of child-health work in the State of Missouri within the past year a very liberal appropriation for health work has been made, including funds for child-health work. The legislature has passed a very acceptable physical education law, and if I may believe the statements of those who have been interested in this form of legislation, this also has been largely due to the influence and work of the Public Health Service in the State.

At the request of the reconstruction commission of the State of Delaware, which is engaged in child welfare work in that State, the Public Health Service assigned an officer to that State to direct the medical activities of the reconstruction commission. Prior to his advent into the State a number of different organizations were working at cross purposes. The appropriation to the commission was $25,000 a year. The school and medical inspection work was carried on by the board of education irrespective of the work of the reconstruction commission. Since our representative has been there the conflicting agencies have united in the support of his medical program. He has been designated chief medical inspector of schools by the State board of education. He has succeeded in securing from private sources an appropriation for the establishment of dental and eye clinics for school children. In part, as a result of his advice and counsel, the legislature this year appropriated $60,000 a year for two years to carry on the child hygiene work of the State of Delaware.

In Mississippi we have been, during the past year, cooperating with the State board of health in the study of child hygiene organiation. I wish to say in the brief time we have been there very onderful things have been accomplished. If the program outlined y service representatives in consultation with the State health officer s carried out, in the next three years Mississippi will have accomlished the most definite and most lasting piece of child health work f any State in the United States.

In Tennessee in the State board of health they have a division of ral hygiene. This division of oral hygiene has organized for the xpress purpose of educating in oral hygiene. They have no authorty or power or appropriations to do otherwise. At the request of he State health officer we sent into the State of Tennessee last year ur mouth hygiene unit comprising a dental surgeon, a mouth hyienist, and a moving-picture machine outfit dealing with oral hygiene ollowing an itinerary which was mapped out by the State board f health. We have visited a number of communities and there we ave studied the mouth hygiene problems through the instrumentality f the nurse. We have called the people together in consultation and hey have seen the moving picture. We have presented to them their roblem of mouth hygiene. The result is that in that State we have efinitely established eight school dental clinics and halfway estabished five school dental clinics.

The Public Health Service has been specially interested in the ealth of school children for a number of years. First, because the revalence of certain endemic diseases in the school population is a air index of the health of the community, and, second, because of the reat importance of conserving the health of the rising generation nd teaching proper health habits. On request of the commissioner f health of Minneapolis, the service has made a study of school superision in that city, pointed out certain defects, and advised reorganiation of certain phases of the work along progressive lines. It is elt that the recommendations made by the service in the main will e adopted. The city government of Minneapolis is administered rgely by a system of boards of which the board of education is elecive and administers the health work in the public schools. The city oard of health operates under the board of public welfare, which has o direct administrative relationship to the board of education. Durg the year the board of education, with the consent of the board of ublic welfare, designated the city health officer as director of the ivision of hygiene of the board of education to direct the health ork in the schools. One of the recommendations made by the service epresentative for reorganizing the school health work provided for e utilization of the nursing service of both the board of education nd the board of health for combined school and public health work. e found in that city, for example, that in the enforcement of uarantine measures homes were visited by the contagious-disease nurses, tuberculosis nurses, and sanitary inspectors. The Visiting Nursing Association, of which neither the board of education nor the board of public welfare had control, sent their nurses into the homes and, finally, the workers of the dental society and of the local tuberculosis association also visited the various homes. It was felt that under the united administration of health work by the city health department a large part of duplication of effort and activity so annoying to individual householders would be prevented.

In Georgia, during the past year, the service, at the request of the State health officer, has made a study of the child health supervision in that State and assisted in organizing the State Bureau of child hygiene. This has resulted in the State's adopting a very comprehensive program of child hygiene carried out now by a director, who at first was an understudy of the service representative.

In Oregon we undertook on a very large scale at a comparatively small expense, a form of health work which has not yet been engaged in very extensively by State health authorities. By a special resolution of the legislature, the University of Oregon was authorized to conduct a survey of dependency, delinquency, and feeble-mindedness in that State, with a view to submitting a report as the basis of legislative action for proper care of this element of the population. At the request of the university, which request received the indorsement of the State health officer, an officer of the service was assigned to undertake this survey which was made on a State-wide basis. These are some of the results of this survey. According to the 1920 census, the population of this State was 783,285 people. Of that number 3,984 were found to be insane, with a ratio of 5 per 1,000 of the population. In the survey of mentally defective in communities under special consideration we found 1,733 definitely mentally defective.

We found on examination of 30,140 delinquents 1,014 were mentally defective, and of the 2,955 dependents examined, there were 955 mentally defective. The total cases of mentally defective were 3,702, a ratio of 4.7 per 1,000 of population. The combined total of all noninsane and mentally defectives, delinquents, and all dependents was 7,686, a ratio of 9.8 per 1,000 of population. The total number of potential or actual social liabilities, a class of people which seriously adds to the problems which confront health officers was 65,423. Excluding half of the delinquents which were considered only slightly delinquent, and half of the dependents whose dependency could be easily remedied, a total remains of 45,574 persons which represents 5.8 per cent of the population. Excluding every known case of insanity and gross mental defects, the other half of the delinquents and one-half of the dependents, we have 29,843 individuals. The larger part of all public expenditures for relief, care, treatment, and training of misfits of the State was caused by approximately 4 per cent of its inhabitants.

A good part of our work during the past year has been of special research nature. Last year we made a preliminary report of the work which we had undertaken in the city of Boston in cooperation with the Boston Baby Hygiene Association and other agencies to determine the usability and value of dried milk products as an exclusive food for infants. The prime requisites for a child considered in this study were that it should be under 6 months of age, that it should be exclusively bottle fed, and that it should be under the supervision of the Boston Baby Hygiene Association. I am not going to go into details about this work. However, judging by gain n weight—that is, the average daily gain in weight—it was found that the children fed on the milk powder (which was made from whole milk and contained 3½ per cent butter fat) gained more constantly and at a greater rate than children fed on either the grade A milk, which was used as a control, or those fed on reconstructed milk made from the milk powder with the addition of butter fat. So far as our studies have gone, we are led to the very important conclusion that the brand of dried milk powder which we used was safe, and that in some instances, in certain classes of cases, it exerted a distinct therapeutic effect.

Some rather interesting side issues were recorded in the course of hese studies. We made a study of the bacterial content of grade A milk, the whole milk made up in the home, and the reconstructed milk, and we found that milk from the whole milk powder had he lowest bacterial content; that next was the reconstructed milk, which was reconstructed by a large dairy company that cooperated with the service and distributed this milk to the homes of the children. This interesting fact also developed, that the bacterial content of the reconstituted whole milk powder made up in the home was less ffected by the changes in temperature. When the temperature went up the bacterial content did not rise in proportion to that of he other two preparations.

The Boston Baby Hygiene Association instructs all mothers of hildren under supervision regarding the use of orange juice. For ome reason or other about 15 of our children failed to secure he orange juice and two of them developed symptoms of scurvy. 'hese were promptly detected by the physician and each responded romptly to treatment. One of these children was fed on grade A milk and the other was fed on the reconstructed milk made from he skimmed milk powder and butter fat. Since the potency of the ntiscorbutic substance in milk is dependent upon so many factors—he freshness of the milk, the food of the cow, etc.—we can not say with certainty that any market milk contains a sufficient quantity of antiscorbutic food value. Whether we put the child on ordinary cow's milk or milk made from milk powder, it is in accord with sound therapeutic practice that we give it orange juice.

Another interesting thing brought out in these studies related to the occurrence of rickets. You doubtless know the etiology of rickets is a subject of controversy. Mellanby, of England, was an advocate of the theory, which received rather wide acceptance, that the fat soluble vitamine was the principal antirachitic substance in food. We had careful physical examinations made of these children for the determination of the existence of rickets amongst them, and were rather surprised at the great amount of rickets which was discovered. At a later exemination we found that rickets was practically of equal distribution in the children of all three classes, and as all three of these classes were given butter fat in the quantity which would be given to children of a given age, we could not find any association between the fat soluble vitamine and rickets as a result of our study. Since these children were recruited from homes of varying degrees of cleanliness and intelligence in the observation of sanitary requirements, we feel that in the determination of the cause of rickets, we must take into consideration other factors than the presence or absence of fat soluble A.

For a number of years we have been impressed with the desirability of having uniform schedules for recording health data, so that material collected in one part of the country may be uniformly comparable with that obtained in other sections. Based on experience of past years, the Public Health Service has devised a number of forms for use in child health work which it is hoped will meet many of the objections to forms previously used. One of the principal objections to the forms which we have previously presented to you was that they were too complicated. In the present revision we have eliminated all extraneous matter and asked for only such data as will have a distinct bearing on the health of the individual and that of the community. In other words, a school medical inspection card should not only show the physical condition of the child but it should also be so arranged and kept as, in the aggregate, to serve as the basis of an index of the general health of the community. The Public Health Service has now adopted forms for prenatal care, care of the child or infant of preschool age, a card for recording the results of physical examination of school children and a card for recording the results of dental inspection. The perfect form has not been devised. However, the fundamental facts are common to all communities and it is hoped that in time agreement may be reached on the adoption of uniform child health schedules for use throughout the country.

During the coming year the Public Health Service purposes to undertake certain studies in nutrition which we feel is of very marked importance. At the present time the interest of the majority of workers in the field of child health is centered on nutrition and many fads and fancies are to the front. According to the quite generally accepted practice a child is considered undernourished depending on whether he falls below a certain arbitrary standard of height and weight correlation. There are in use in this country at the present time several standards of height and weight for a given sex at a given age period. A number of these so-called standards are more or less empirical and are based on averages of measurements which in the aggregate represent nothing more than a collection of figures. During the year we have attended two conferences which were called by Dr. L. Emmett Holt, of New York, to consider this problem. As yet, we have not arrived at an agreement as to what constitutes the accepted standard of physical development. The Public Health Service purposes to make special studies and secure accurate measurements of normal children free from hampering defects, and approach the problem from a new angle in an endeavor to arrive at a standard that will be acceptable and which will more nearly approximate the ideal.

Finally, I can only mention, by reason of time limitation, certain other problems of child hygiene which should receive careful consideration by the health authorities. I feel that the health authorities should give greater attention to public health education and that an attempt should be made to reconcile the long-standing differences with the educational authorities regarding jurisdiction over health matters affecting school children, with a view to utilizing the combined wisdom of the health authorities on the one hand and of the educational authorities on the other in properly instructing the rising generation in matters relating to preservation of health and the cultivation of health habits. Studies should be undertaken of antenatal and neonatal pathology in order that the vital statistics of children may be more accurate. The average physician in certifying the cause of death of a young infant is confronted by such terms as "marasmus" or "congenital debility" and blindly selects one or the other of a number of indefinite terms which convey no real meaning, because of the lack of knowledge of the true pathology of this period of life. Again when we reflect that from 75 to 90 per cent of the population have been infected with tuberculosis by the time they reach 15 years of age it seems to me that it is about time the health authorities devote some special attention to the study of tuberculosis from the standpoint of the relation of tuberculosis in infancy and early childhood to tuberculosis in the adult life.

Dr. McCormack. Last year Dr. Leathers was kind enough to ask me to come to Mississippi at the school for health officers and I saw the splendid work done in cooperation between the service and the bureau which impressed me as to the greatest piece of work I have ever seen done anywhere by the bureau which is reinforcing the State health department in the work of an organized county health department and in organizing child hygiene as a fore runner of the organization of the county health department.

Dr. Clark was good enough to assign a physician of the service in the same class of work. I think the one scheme suggested by that officer which has been worth while more than any other thing I have seen done is this. She has this blank sheet on which the roster of each schoolroom is printed in large letters and tacked on the wall of the room. After checking up the ordinary examinations of those who come up to the standard, to which Dr. Clark has referred, a blue star is pasted on after the name of each child. Where there are defects below the standard, the place is left blank. As soon as these defects are corrected, a red star goes in there and when that child has no defects or when they have been corrected, a gold star is put in front of the name and each of these children are on the health board for that room to help in keeping defects of the others corrected. The children themselves are helping to educate the parents as to the necessity for the correction of the defects. It saves visits from the nurses and health officers and defects are corrected more quickly and the children themselves are insisting that their tonsils be taken out or whatever other defect or disease they have be corrected. The other day I met one of the men on the street and he said, " My kid has been bothering me to get his tonsils out and I told him I never had to have my tonsils removed." He said, " I expect that's what's the matter with you. You snore and if you had them removed you would be a better man now."

That is one of the nicest schemes I have seen which the service has performed for us in Kentucky, in addition to the many pieces of cooperative work they have been doing. In this respect one of the finest pieces of work has been done.

I want to express my gratitude to the service as a whole and to Dr. Clark and his assistant, which means very much to the children of Kentucky. It is a valuable and practical piece of work.

Dr. Noble. I want to say as briefly as I can what we would like you to know of the program of the State Department of Health of Pennsylvania. Dr. Clark was right when he said Child Welfare was the most important subject. The child *is* the most important being in the universe, and our department of health looks upon its youngest citizens as its most important wards.

Every community should take its health problem upon its own shoulders. It should have the advice and counsel of the State officials, but so far as its own work is concerned, it should take the responsibility itself.

We are convinced that an important part of infant mortality is due to syphilitic infection of one or both parents. Extreme statements need not be made here, but if we can get ahead of the social diseases we will get ahead of a large factor in the infant death rate.

The question as to what are the most important points to emphasize in constructive child health work points us to four or five cardinal considerations. We think that every child should be perfectly fed; that the question of diet is at the top of the list. We are running, just now, the beginning of a great campaign for breast feeding. Every mother should nurse her baby and every child is entitled to be fed by its mother. We are sending out through the State a good deal of material to nurses and doctors and are planning to get to the laity for education later. That will be needed to make effective a tremendous campaign so that every child will have a square deal.

Next to nutrition we will perhaps place "skin ventilation." This combines two factors—right bathing habits and right clothing. The latter in hot weather should receive great emphasis. We would not like to have anyone infer that we are backing down on the necessity of more bathing rather than less, but keeping the skin surface "ventilated" by sufficiently thin clothing is expedient.

An extremely interesting survey was made by the Prudential Insurance Co. in the town of York, Pa., last summer. They have made a diagram which shows that with every decline in the temperature there was a decline in the morbidity among children suffering from summer complaint; when the temperature rose the morbidity in summer complaint rose correspondingly. We would like to have every mother understand that she should keep the air about the baby slowly active, if possible, during the times when the temperature is high. Such measures increase the resistance of the child and lessen the incidence of disease.

To the end that our education in health details should be carried out, we have a large number of health centers. Our ideal for health centers in Pennsylvania is to have them in all communities to meet the necessity for every kind of family, so that every mother may have available the information she needs. Malnutrition, for example, exists in the upper strata as well as in the lower, and we want all mothers to come to the health centers, rich or poor. Such centers are to look after the little baby, the preschool child, the older school child, the adolescent and the mother herself before the babies are born. The well-organized center has all of these groups as legitimate bases for its activities. No center is to be a hospital; it is not a place where sick children are treated; and it is, therefore, endangering no doctor's practice.

As to the housing of its various kinds of work, the health center may consist of one room, or it may occupy a whole building. The individual mother as she accompanies her child for its examination receives instructions; or the mothers are taught in groups. We preach the gospel of the six necessary so-called "health habits"—right eating, dressing, bathing, sleeping, work, and play.

Our prenatal work is of great importance because here again the rich mother as well as the poor one is often ignorant of some of the few simple things about keeping herself well during pregnancy. The mother is only going to give her child a square deal when she takes the proper care of herself prenatally.

The preschool child comes in for a good deal of our attention, i. e., the child between the second and sixth years.

The running of the health center is a matter for the community to undertake. The local health officers should cooperate in such manner as to uphold the center.

There must be, also, a strong committee of lay workers. We have worked out a practical plan by which we are enabled to hand over to every community a printed "Technique" giving full instructions how lay people may back up the health center.

As to legislation, we feel we have enough health laws in Pennsylvania. They may not be as perfect as in other States, but we feel all the necessary ground has been covered.

Silver nitrate treatment in ophthalmia neonatorum is not required by law. It was made reportable in Pennsylvania in 1913. We are aware that other States have legislated to make silver nitrate applications compulsory. Statistics show that Pennsylvania, in 1919, had an incidence of only 10 cases of ophthalmia to about 100,000 population, whereas some other States have from 50 to 100 cases for every 100,000 population. We are conservative in our legislation, not feeling justified in making things compulsory which may be a matter of psychology rather than preventive medicine.

Dr. SCHERESCHEWSKY. I want to congratulate the State Department of Health of Pennsylvania for having a division of child hygiene in which the outlook seems so sound and in accord with what should be the best practice and with high ideals. The two things which impressed me very much were, first, the fact that the State department of health feels that the responsibility for the health of the children is a responsibility of the local communities, and that the State department of health was doing what it could to develop that sense of responsibility in the community. That is the course which is going to bring child conservation into its proper channel. The other thing which Dr. Noble spoke of was the fact that the State department of health is recognizing the great effect of temperature in influencing the infant mortality. That is, by all means, a subject which we should study closer. It has an intimate and close correlation with the summer mortality of infants, keeping the children cool. We have gone a little too far in our desire to lay our infant mortality to bacterial infections. I was glad to hear Dr. Noble say that in their work in the State Department of Health of Pennsylvania the meteorological conditions were given further recognition and study.

Dr. LEATHERS. I think we owe the service a debt of gratitude for the splendid cooperation they have given us in the organization of child hygiene work in Mississippi. I may state that during the last session of the legislature, which was in the beginning of 1920, we got an appropriation of $10,000 for this work. The appropriation requested was $40,000 but on advice from the State department of health it was reduced to $10,000 because we felt that the work could not be organized within a period of six months and that the $10,000 would be sufficient to start the work. This year, 1921, we have $30,000 for child hygiene work.

After having waited some months endeavoring to find some one to take up this work, I found great difficulty in getting a person whom I thought would be competent to make a success of it. Incidentally I had a talk with Dr. Clark in Washington and he said he would gladly help in any way possible and through his cooperation we have gotten this work upon a most effective basis.

In studying the child welfare work as done in different States one of the things which impressed me was this, there seemed to be a lack of definiteness about it. There was a general program conducted in child welfare work because this subject is of general interest. It appeared to me that if child welfare work were to be successful it had to be organized on a perfectly definite basis. We have proceeded upon the idea that the way we can get best results would be to have child welfare units organized that could be placed in counties and after they had done a definite piece of work, in a particular county, they could be transferred to other counties.

Each unit consists of a woman physician, a nurse, and a clerical helper. We refused to take up this work in any community unless that county made an appropriation for it, somewhat upon the idea that Dr. Scherechewsky mentioned a moment ago, that it would be unwise for us to go into a county without requiring the board of supervisors of the county to assume some financial responsibility. They make an appropriation of $1,000 to begin with, then we go in and undertake the work. Our difficulty has been during the past few months to meet the invitations that have been extended to us from the respective counties. We have now three or four counties waiting. We could easily increase the appropriation from $1,000 to $2,000 and still go ahead with the work.

It may be of interest to hear a few points about the plan. We have a series of bureau letters outlining definitely all the procedure which each unit must follow. When a unit goes into a county the physician of the unit is supplied with these letters. One letter has in it the list of supplies which she needs and information how to get them. Another calls her attention to certain agencies in the county and how she may form an affiliation with these agencies. Another specifies certain points she should emphasize in the campaign. I want to refer particularly to just what the physician should do, especially in making the examination of school children. When the unit goes into a county the idea is that every child must be looked over by that unit and a record made and kept of the children. We felt that a certain standard should be held up to the people, but not too high a standard. This is the standard being held up to the people of the State this year; it may be changed from time to time:

Eyes: Vision normal, or corrected by glasses; any evidence of disease or inflammation.

Nose: Any adenoids or other obstruction.

Throat: Any disease; enlarged tonsils or other inflammation.

Mouth: Any inflamed cavities in teeth; teeth clean; showing evidence of care; gums healthy.

Glands: Any inflammation.

Scalp: Clean; free from pediculosis.

Lungs: Any evidence of disease.

Vaccination: A scar, or certificate of recent vaccination.

Nutrition: Weight normal, or not more than 10 pounds under.

Free from hookworm, as shown by negative report.

We are trying to have every child have an examination of the vision and to become vaccinated, if not having been vaccinated. We do not want a standard that can not be complied with. Any child can comply with this standard. Our idea was to approach the children in the child's way. We must realize the fact that just as the teacher approaches the child in the day school or the Sunday school, if we are going to get the best results we must approach the child from the child's point of view. We have a health record sheet. After a school has been gone over, a roster is made of the children showing how they stand on the above standard. It is not humiliating to the children because many of them can measure up to this standard. There is a great deal of interest shown; the children get around the chart and talk about it. We use stars simply to create interest. A red star is used to indicate when a child is normal upon first examination. As the defects are corrected a blue star is attached corresponding to each defect corrected. If a child can not correct a defect, like some deformity, but has corrected everything else, then we place a silver star opposite the child's name because he has done all that could be done. If he has corrected all the defects, we place a gold star on the health record sheet. It is interesting to see how much initiative the child shows in getting these things done himself. This will tend to develop in the child individual responsibility relative to his or her health.

Dr. Hurty. In 1907 the State Board of Health of Indiana passed a resolution that there were two things fundamental in public health work. One was the great subject of heredity, which we have not reached yet in Indiana, nor in hygiene convention. A person must be well born to get anywhere; a person born without mind or brain is an idiot and can not arrive. The fundamental thing is to have good heredity. The next is to be well reared.

We secured a small appropriation of $5,000 from the legislature and our first work was to write, publish, and distribute the Indiana Mother's Baby Book. We had a great discussion as to whether that should be cloth bound or paper bound. We had it cloth bound. We felt we then had a book for the library of every home, a book that people would keep. When a birth was reported a letter would go from the State board of health and also from the governor, congratulating the mother, telling her that she was a good citizen, that she had contributed to the greatness of the State, and herewith the State sent her a book.

At last we have a real child hygiene division. It is on wheels, its exhibits carried in automobiles, and we are taking the story of good birth and right rearing into the country homes. We have 92 counties and nurses in 63 of them. A large truck transports the exhibits and moving-picture machine, also a stereopticon and slides. The coming of the division is advertised beforehand. Preachers have been written to and all the officials and every school-teacher in every county. We ask them to pass the information on and stir up that county on the subject. Meantime the nurse in that county has made the medical school inspection of the children, and where she could not make this inspection the health officers have made it. I might mention here the trouble we have in getting an all-time health-office system. It is because the chiropractors, the osteopaths, and Christian scientists are opposing in every way.

This division goes into the center of the county where they have 20,000 to 80,000 population. The people are informed where the exhibit is to be, where the lectures will be given, where the babies will be examined; and the mothers bring their babies there. They are provided with the framework for setting up cubicles, scales for weighing the children, etc. That county is simply plowed and harrowed and sown with this subject, if your children are well born and rightly reared you will do away with much sickness and a large percentage of social troubles. My father was a teacher and thought education would remove all of our ills. It has not met expectations, for morals are not improved, neither is disease reduced, and there is just as much crime, poverty, and insanity as ever. Heredity is the thing that counts. You have to be born well to get anywhere. We formulated a child's creed and sent it to every newspaper in the State and asked them to make an editorial upon it. That creed read like this:

> Every child has the inalienable right to be born free from disease, free from deformity and with pure blood in its veins and arteries.

If we take that inalienable right from the child we are a lost Nation eventually. It is real men and women we want, born with a physical and moral nature. If we are not born with these characters, we can't develop to high and useful manhood. The second clause in our child creed is as follows:

> Every child has the inalienable right to be loved, to have its individuality respected, to be protected in body, mind, and soul; to be protected from evil persons and evil things, and to be brought up in the fear and admonition of the Lord.

If we secure these two inalienable rights for our children, our health and social problems will be largely solved. We submitted our creed to Gov. Marshall. He read it several times and said "I will put that in my pocket; that strikes me." A few days afterwards he had inscribed below this:

> Any State which does not ceaselessly strive to secure these inalienable rights to its children is a delinquent State.

Let us get across as rapidly as we can the idea that we must be better born.

In one of our towns where several of our literary lights were born (Gen. Lew Wallace was born there) the first visit I made was to the home of a man and a woman who were distinct morons. The family numbered ten. They were living really worse than hogs. They never had had the least bit of sickness in the family. Diphtheria had been epidemic, but that nest of high grade imbeciles did not suffer. Every one of them was feeble-minded and smelled terribly. We have a law stating that when children emanate a bad smell they shall be sent home from school and if they are not made clean and sent back, the truancy officer gets after them and cleans them up. What does it amount to to these people? They won't stay clean because they haven't cleanliness in them.

After our child hygiene division has visited a county and stirred it up, a follow-up agent visits that county about a week afterwards. He visits the ministers to get them interested, and tells them, " You must look after the child; the Master has told you to do so." In every county we try to organize an active well-working organization, a suitable child hygiene organization in each community. We try to get the business men interested, and we post the towns with the following: " The most important business before the business men to-day is the business of the public health." They think of it, and progress and understanding of the health problem result.

I wish we could post the whole State with this message. My message to public-health workers is, Do not forget that heredity is a factor not to be neglected when health problems are to be solved. *One can not gather figs of thistles.*

Dr. Knight. Our program in child hygiene investigations has this year been extended, and we have gone into 50 counties and 75 towns of the State. A house-to-house canvass has been made in 20 of these towns. One of the remarkable points of this survey shows that breast feeding of infants is not a problem in Missouri, but the child of preschool age, in not having an adequate supply of milk, is. Of the mothers interviewed, 50 per cent of the children received less than a pint of milk a day, and the majority show evidence of malnutrition. Regarding the school child, we have no special problem. In the correction of 105,000 children (which is about 25 or 30 per cent of the total rural-school population) there have been about 30 per cent corrections for physical defects. I am at this time unable to give a detailed report of the work. The figures are coming in from the nurses from time to time.

In 1919 there were only two public-health nurses in rural Missouri; to-day there are 36 on duty. Where these are located there is some form of follow-up work inaugurated. There is established a clinic or health center, which takes care of the expectant mother, the infant, the child of preschool age, and, during the school session, the school child. We have on register 500 mothers receiving prenatal letters, and after the birth of the baby, lessons on care of the baby. This may not seem important, but I had many letters from districts in Missouri where there is probably not a physician or nurse, saying, "I lost my first two babies, and after receiving the advice from you we secured a nurse and a good physician, and we are happy to say the baby is healthy." That means a good deal.

Relative to legislation: There was passed during the last session of the legislature a bill for the prevention of ophthalmia neonatorum, and regulating the practice of the use of nitrate of silver for this condition. Another piece of legislation was the physical education with certainty that any market milk contains a sufficient quantity of antiscorbutic food value. Whether we put the child on ordinary cow's milk or milk made from milk powder, it is in accord with sound therapeutic practice that we give it orange juice.

Another interesting thing brought out in these studies related to the occurrence of rickets. You doubtless know the etiology of rickets is a subject of controversy. Mellanby, of England, was an advocate of the theory, which received rather wide acceptance, that the fat soluble vitamine was the principal antirachitic substance in food. We had careful physical examinations made of these children for the determination of the existence of rickets amongst them, and were rather surprised at the great amount of rickets which was discovered. At a later exemination we found that rickets was practically of equal distribution in the children of all three classes, and as all three of these classes were given butter fat in the quantity which would be given to children of a given age, we could not find any association between the fat soluble vitamine and rickets as a result of our study. Since these children were recruited from homes of varying degrees of cleanliness and intelligence in the observation of sanitary requirements, we feel that in the determination of the cause of rickets, we must take into consideration other factors than the presence or absence of fat soluble A.

For a number of years we have been impressed with the desirability of having uniform schedules for recording health data, so that material collected in one part of the country may be uniformly comparable with that obtained in other sections. Based on experience of past years, the Public Health Service has devised a number of forms for use in child health work which it is hoped will meet many of the objections to forms previously used. One of the principal objections to the forms which we have previously presented to you was that they were too complicated. In the present revision we have eliminated all extraneous matter and asked for only such data as will have a distinct bearing on the health of the individual and that of the community. In other words, a school medical inspection card should not only show the physical condition of the child but it should also be so arranged and kept as, in the aggregate. to serve as the basis of an index of the general health of the community. The Public Health Service has now adopted forms for prenatal care, care of the child or infant of preschool age, a card for recording the results of physical examination of school children, and a card for recording the results of dental inspection. The perfect form has not been devised. However, the fundamental facts are common to all communities and it is hoped that in time agreement may be reached on the adoption of uniform child health schedules for use throughout the country.

During the coming year the Public Health Service purposes to undertake certain studies in nutrition which we feel is of very marked importance. At the present time the interest of the majority of workers in the field of child health is centered on nutrition and many fads and fancies are to the front. According to the quite generally accepted practice a child is considered undernourished depending on whether he falls below a certain arbitrary standard of height and weight correlation. There are in use in this country at the present time several standards of height and weight for a given sex at a given age period. A number of these so-called standards are more or less empirical and are based on averages of measurements which in the aggregate represent nothing more than a collection of figures. During the year we have attended two conferences which were called by Dr. L. Emmett Holt, of New York, to consider this problem. As yet, we have not arrived at an agreement as to what constitutes the accepted standard of physical development. The Public Health Service purposes to make special studies and secure accurate measurements of normal children free from hampering defects, and approach the problem from a new angle in an endeavor to arrive at a standard that will be acceptable and which will more nearly approximate the ideal.

Finally, I can only mention, by reason of time limitation, certain other problems of child hygiene which should receive careful consideration by the health authorities. I feel that the health authorities should give greater attention to public health education and that an attempt should be made to reconcile the long-standing differences with the educational authorities regarding jurisdiction over health matters affecting school children, with a view to utilizing the combined wisdom of the health authorities on the one hand and of the educational authorities on the other in properly instructing the rising generation in matters relating to preservation of health and the cultivation of health habits. Studies should be undertaken of antenatal and neonatal pathology in order that the vital statistics of children may be more accurate. The average physician in certifying the cause of death of a young infant is confronted by such terms as "marasmus" or "congenital debility" and blindly selects one or the other of a number of indefinite terms which convey no real meaning, because of the lack of knowledge of the true pathology of this period of life. Again when we reflect that from 75 to 90 per cent of the population have been infected with tuberculosis by the time they reach 15 years of age it seems to me that it is about time the health authorities devote some special attention to the study of tuberculosis from the standpoint of the relation of tuberculosis in infancy and early childhood to tuberculosis in the adult life.

When these went to the finance committee to make up the appropriation bill they used the pruning process, except for venereal disease; they did not touch that. On the other hand, after it went into the appropriation bill they said, "Is this enough?" Now, why did they do it? Just because public sentiment of that State had been molded by the energetic propaganda to the necessity of the prevention and control of these diseases. That is the explanation why there was no effort made to cut that appropriation where they were trying to cut all other divisions. The same thing is true of child hygiene. Two years ago there was a law making it compulsory to have physical examination of the school children. We had no funds with which to do the work. We have secured fairly adequate funds for use during the coming two years by carrying on some propaganda, and we secured that appropriation in the face of the opposition of certain elements stating that the Public Health Service was doing nothing and had done nothing toward the betterment of the child.

Dr. LORIMER. In our State we have had little along that line. The legislature itself is not educated. There was a bill before the legislature to regulate the practice of medicine in Colorado this last winter and the senator from our district is a personal friend of mine. This man was clamoring very much for a bill to create a cantaloupe inspector at $5,000 a year. I suppose he had in mind the protection of you eastern people from botulism. When I wrote to him in reference to the medical practice act he ignored it; then I called his attention to the fact that people were more important than cantaloupes. I called his attention to the fact that one of his neighbors had employed a chiropractor who had received his medical education by correspondence. Said chiropractor had treated the neighbor's family for a week for stomach trouble and six of them had smallpox and scattered smallpox all over the county. Then I wrote and said: "Dear Ed, I can appreciate your position. This chiropractor belongs to the Dunkard denomination. There are more Dunkards than doctors in the county." What are the means by which we are to educate the public? I believe that through the school-teacher we can do a great deal. If teachers' institutes were asked to have a doctor on their program it would help. as teachers always, as far as my experience goes, show a willingness to cooperate in public-health matters. Last year we had four doctors and one represented the venereal-disease division of the State board of health. I speak of this as one of the agencies by which this campaign of education might be carried on.

Dr. GALLIVAN. I wish to remind the members of the conference of the two trips planned by the State department of public health. Tomorrow morning, 9 o'clock, arrangements have been made for conveying this party to Rhode Island by automobile. We will meet on the street back of this building.

Monday morning, same hour Boston time, same place. Trip to the State Sanatorium at Rutland.

Mr. **Sydenstricker.** These charts are based on the work in Missouri. We tried to experiment in Missouri on the morbidity of school children, getting the school-teachers to record the absenteeism on account of sickness, with a statement of the cause of sickness. We found we actually did get results.

Dr. **Stiles.** In connection with that chart, might we bring before the meeting a little piece of history in connection with Roosevelt's Commission on Country Life? The question came up as to the best source from which to gather information on all sorts of matters. We had hundreds of lives tabulated according to the occupation of the person who gave us the replies. We found that uniformly throughout the country our most trustworthy information came from the schools through the school-teachers. They were the thinking people of the community. Next to the lowest quality of information came from the real estate people, and the least trustworthy came from the United States officials, including postmasters.

The **Chairman.** Will Dr. Kerr tell us something of what he is doing?

Dr. **Kerr.** Mr. Chairman and members of the conference, it gives me great pleasure to be present this afternoon. The first conference of this kind which I attended was in 1906. I see many faces that were present at that time. These men are to be complimented for their long and faithful work. The health officials of the counties and States generally are to be complimented on the standard of their work carried on oftentimes against opposition, and on the success they have had.

Within a period of 20 years, ended 1918, tuberculosis has been reduced from about 201 to 149 per 100,000. Typhoid fever has been reduced from 35.9 to 12.5. Child mortality has been reduced from 137.7 in 1910 to 110.7 in 1918, and the expectancy of life since 1897 has been increased in the State of Massachusetts from 45.4 to 51.49 years. I have had deep interest in the work you have been carrying on and, in a way, have been associated with it, though among a different class of people. At Ellis Island in the neighborhood of a million prospective citizens are born every year. The enforcement of the law has been more difficult during the past two or three years. In consequence, we have had a larger number of detentions. In the hospital there are approximately 650 at all times. A large number are children who will remain there for a considerable period because of the authority granted to the Secretary of Labor to authorize treatment in certain cases. A good many are not really ill. Therefore they present a problem in their care. When the number grew to considerable proportions we wondered what we were to do with them. It relieved the nurses for a little time to give them each day instruction which we felt they should have after they get into the country. One outcome of the war has been the establishment in our hospitals of occupational therapy nurses. It is not practical to teach these smaller children textile weaving, etc., and we, therefore, decided to put them in classes and give them instruction of an elementary character. The chief occupational therapy nurse asked me, "What shall I teach these children?" I answered, "If you will teach them to speak and read the English language, to recite the first paragraph of the Declaration of Independence, and sing 'My Country, 'Tis of Thee,' I think we shall have made their stay in the hospital of some advantage to them."

During the past 15 months we have had several hundred of these children. At present there are 150 in classes. When they go into these classes they can't talk a word of English, but in about six weeks they begin to talk it. We teach them not only English but other things. They are given toothbrush drills, instruction in what to eat at the table and why, what advantage to them there is in this instruction, etc. We are trying to give them, in a brief period in which we come in contact with them, a little insight not only of the ideals of America but the way they should live in America. Twenty-nine per cent of the total population of the city of New York is foreign born. Those of us who are born here, and especially in the cities along the Atlantic seaport, should realize that, from a public health standpoint, the immigrant is of great importance; his influence on the future life and safety of the country is tremendous.

I believe that this idea of practical instruction should be carried into the cities and into the communities in some way, not in a dictatorial manner or in the form of an edict, but in the form of pleasing instruction, and I believe it can be done. In my own family, experience has taught me that there are avenues of interesting children in public health that perhaps have not been utilized to the extent to which they should have been. I have in mind the Boy Scouts, Girl Scouts, and Camp Fire Girls. My daughter is a member of one of the camp fires. I am amazed at times at the methods they take and at the benefits they accomplish. The leader in my community can have a greater influence almost than her parents can. My daughter will sleep with her windows open and has not slept with them down for the last six months because she got a certain colored marble for not doing so. The girls are taken out on hikes. They are given nature studies and talks on hygiene, and for remembering what is told them they get marbles. My daughter has earned a whole bag of marbles, and I don't know what they mean but she does.

If we could take these ideas and associate ourselves with such agencies, then use them and give them the ideas we want to convey to the children I think we would find we had a great arm of usefulness that has not been used to the fullest extent.

The CHAIRMAN. Dr. Kerr's reminiscing about the first meeting calls to those of us who are older the days when we spent most of our time on embalming and transportation of the dead.

Dr. CLARK. I wish to say that the time allotted to us was so fully taken up in describing to you the work of the service in child hygiene during the past year that we did not attempt to dwell on individual child welfare problems. We have not been unmindful of school inspection, follow-up work, establishment of clinics for prenatal and infant care, the problems of mouth hygiene as related to the health of children, and a host of other child hygiene problems which might be mentioned.

We do wish to emphasize particularly the relationship of child health work to all forms of health activity. Dr. Kerr has mentioned the work that he is doing among children in connection with the examination of arriving immigrants. The control of venereal diseases is intimately associated with blindness and infant mortality. The work which the service has recently been engaged in in the city of Washington in cooperation with the juvenile court in determining the mental and physical status of delinquents also shows this interrelationship. A routine Wassermann and physical examination of these delinquents showed that approximately 2 per cent of the white boys, 4 per cent of the colored boys, 7 per cent of the white girls, and 22 per cent of the colored girls were suffering from venereal diseases.

With regard to nutrition work, I was especially impressed, during a recent visit to Mississippi, by the work done there by Dr. Leathers. Dr. Leathers employs a very capable nutrition worker who visits the communities and gives instruction in nutrition. In one of the counties visited by us we found that of 2,270 children only 4 children came up to a prescribed minimum health standard. Of the large number of children who were below the standard, a great number of them were obviously undernourished. This particular county is probably the most heavily infected with hookworm of any county in the State. This again shows markedly the interrelationship of all health problems, because the physical health of the children of this community, from the standpoint of nutrition, can not be restored without the eradication of hookworm, which is one of the major health problems of the State.

REGISTRATION AREA FOR MORBIDITY REPORTS.

Mr. SYDENSTRICKER. There is one suggestion, Mr. Chairman, that I would like to put before the conference. If I am informed correctly, as a result of the report of the committee on morbidity returns a resolution was put before the conference yesterday regarding the establishment of a morbidity registration area. We have been gathering statistical data to see what we could do along that line, but we have found out that a morbidity registration area is not something you can create by a wave of the hand. It is something for which you must have a basis and a definite understanding of what we are working for. I am not going to take the time to go into details, but fundamentally we must have some standard on which we all agree and to which States and communities must come up in order to enter the morbidity registration area. It seems to me that it is the province of this conference of State health officers to suggest a policy and to work out such a standard. I think Dr. Fulton brought out in his discussion a suggestion for one such standard—that is, the fatality rate. Another suggestion has been made in the publications that we take the morbidity reports from certain diseases in some city or State where registration is supposed to be good and use that as a standard. Or we can do probably what is even better, follow the lines of the mortality registration area and establish a standard for certain diseases by actual surveys of sample populations. This is a matter upon which we will have to agree if we are going to do anything along the lines of the establishment of a morbidity registration area.

I would like to suggest, Mr. Chairman, that a committee be appointed of State health officers to work with the Public Health Service, particularly the Division of Sanitary Reports and Statistics, to work out practical suggestions for a standard. We can not do anything before such a standard is formulated and I offer that as a practical suggestion.

(It was moved and the motion carried that a committee be appointed of State health officers to cooperate and collaborate with Mr. Sydenstricker of the Public Health Service in this matter, the committee to be appointed later by Dr. Cumming.)

FEDERAL HEALTH POLICIES.

Dr. CUMMING. The Conference of State and Provincial Health Authorities very kindly asked me to read a paper to them at their meeting on Thursday in which this subject was covered, and I will not detain you further than to say that the service will continue to endeavor to cooperate with the State health authorities during the coming year in every way possible.

The next subject is "Tuberculosis—the necessity of developing local facilities in every community for diagnostic and treatment purposes—The tuberculosis ward in every general hospital a necessity," the discussion to be opened by Dr. Smith of the Public Health Service.

TUBERCULOSIS.

Dr. **Smith.** I take it for granted that there is no one here who is satisfied with the tuberculosis campaign as it is at present. You know the history of the tuberculosis campaign—they discovered the bacillus; posted antispit signs; built some hospitals; provided for the disease to be reported—relegated the matter to the specialists and promptly forgot about it. We have built special hospitals in special places—often remote places—in special climates. We have depended upon a few special workers to solve the tuberculosis problem. The average doctor is not interested in tuberculosis. He does not understand tuberculosis, and he is bored by tuberculosis. If he is so unfortunate (and he considers it unfortunate) as to make a diagnosis of tuberculosis he promptly, in his helplessness, prescribes a change of climate to get rid of the patient. It does not make any difference whether that patient lives in the hills of New England, the prairies of the Middle West, or the orange groves of the South, it is a change that is prescribed. That is the attitude of the average doctor, his incompetent and helpless attitude.

One problem in tuberculosis to-day is to popularize treatment in the home climate to prevent the migration of the tuberculous. To popularize home treatment we must unteach something that we have taught tuberculous patients for twenty years. The time has passed when we can build a pauper hospital for tuberculosis and feel that we have done our duty although there are doctors still living who believe it. Our campaign at present is very much as though, instead of sending 2,000,000 troops to France, we had sent over some stretcher bearers. We are not carrying on a constructive campaign against tuberculosis.

Now the tuberculosis death rate is falling but this is due to many causes. The reduction of infection in tuberculosis is part of the general campaign in the reduction of all infectious diseases. Whereever the incidence of the other disease falls, there the incidence of tuberculosis falls also, so it is really a by-product of the campaign that is being made against all diseases, and we ought not to be satisfied with that.

There are two things which this body of health officers can do—first, get the medical schools to teach tuberculosis properly; second, interest the general hospitals and the family doctor in the subject. The average doctor is not interested in tuberculosis—he must be interested. In the medical school he should become proficient in tuberculosis before he gets his diploma. It is only by holding over an undergraduate the fear of flunking that we can induce him to study tuberculosis. The Surgeon General recently caused all medical schools in the United States to be circularized and through a questionnaire it was ascertained that there are only three medical schools in the United States that have professorships in tuberculosis, one is Tufts Medical School here in Boston, one is the Homeopathic College in Chicago, and one is a little school in Tennessee. There are four others, making a total of seven, that count tuberculosis as a major subject. In only seven medical schools in the United States does a man have to pass a special examination in tuberculosis before he gets his diploma. In six others there are assistant professorships, and in three more special instructors. The average amount of time spent on tuberculosis is only one hour per week for eight months. The amount of training in physical examination averages also approximately one hour per week for one school year, ranging from nothing up to 92 hours instruction.

The subject of surgery is well taught in the schools, as it should be. There are seven professorships in surgery in most medical schools. Why is that? It is because this country experienced a revival in surgery some years ago. It became fashionable for every man who went to medical school to become a surgeon. The ceremonious hand washing, the dramatic incision, the averted tragedy, the quick recovery, and the monetary fee inspired every man to be a surgeon. The medical schools at the present time resent, rather naturally, the demands which are being made upon them. But, in demanding a professorship in tuberculosis you may be quite sure that you are absolutely right. There is at the present time scarcely a crossroads town in this country which has not a man reputed to be skilled in removing the appendix, but you have to search the largest cities to find men capable of making early diagnosis of tuberculosis and of carrying out proper treatment. The health officers, more than any other class of men, are in a position to encourage the medical schools and stimulate the doctors to better preparedness in this branch of medicine.

If a man develops tuberculosis what may he do? If he is poor he is sent to the local or county sanatorium; if rich, to Colorado or some distant place, but if he is unfortunately neither rich nor poor he is in difficulties because there are few hospitals where the person of moderate means may receive adequate care for tuberculosis. The average nurse in a general hospital is unskilled in the care of tuberculous patients. She does not even know how to keep a patient warm out of doors; she does not know the meaning of absolute rest. Moreover the average general hospital excludes the tuberculous patient. One of the things which this body may do through its weight, and it is weight that will count, is in encouraging the general hospitals in this country to receive tuberculous patients in special wards and special rooms. If this is done the doctors in a community will become familiar with tuberculosis. They will see the results of treatment, and there will grow up in the hospitals and the community first a toleration, next an interest, and then proficiency in the treatment of tuberculosis in the home climate.

The Surgeon General recently caused all the hospitals in the United States to be interrogated as to their attitude toward tuberculous patients. The replies were surprising. The hospital is leading the procession—it is just a little ahead of the average family doctor in tolerance and general knowledge of the tuberculosis question. Out of 3,900 general hospitals in the United States circularized, 1,400 replied. To the question "Do you admit tuberculosis patients?" only 50 per cent said "No." The reasons given were various. In the very conservative East they took pains to explain to us that they felt it their duty to protect the other patients in the hospital. One little hospital in Arkansas said "No, we have a training school for nurses and we would not think of exposing them to infection." In such States as Colorado, California, New Mexico, and Arizona there was a very encouraging response—the general hospitals did admit tuberculosis cases. Such replies as "Yes, we admit them to private rooms and we fumigate these rooms afterward" were received. Approximately 50 per cent said that they do admit tuberculosis patients under certain circumstances. Many admit tuberculosis patients as a routine practice. They state, and should be proud to say, that they admit tuberculosis patients to their general wards or private rooms as a routine practice. There were not as many hospitals admitting tuberculous patients as a routine practice as admitted them as an emergency measure. It seemed evident in reviewing these 1,400 reports that these hospitals were anxious for you health officers to sanction the admission of tuberculous patients to general hospitals. Such a policy would not only provide additional and convenient facilities for patients unwilling or unsuitable to be sent away to special tuberculosis hospitals, but it would tend to identify the general practitioner with the tuberculosis program. It would encourage the construction of general hospitals in small cities or in counties now unable to support two institutions. It would, moreover, popularize the home climate and assist materially in preventing those unfortunate migrations which have resulted in so many hardships to tuberculous patients and in embarrassment to the communities to which they resort.

Dr. Dowling. I do not know whether it is feasible at this time to refer to folio 6, section 7, of the Quarantine Regulations. There is a regulation which prohibits the travel of tuberculous patients except under certain requirements. It seems to me it would not be a bad idea for the Public Health Service to bring this to the attention of the public again as a general reminder. I think it would attract some attention and act as a stimulus that we have not as yet had. I may say that we have with us Dr. Seemann, who is a member of the Louisiana State tuberculosis commission and who, through his experience, might throw some light on the subject.

Dr. SEEMANN. I was very much surprised indeed to hear some of the remarks of Dr. Smith. I have not had the opportunity to get the information which he has had in regard to the teaching of tuberculosis in the medical schools, but I can not conceive of its being possible for a school of medicine with the high cost of teaching at the present time, where they are running behind all the time, to have a special chair on tuberculosis, any more than they could have one on whooping cough, or one on syphilis, or one on the various types of infection. Down at Tulane University, with which I am most familiar, I am sure I can say the students get quite more than one hour a week of diagnosis of tuberculosis. Physical diagnosis is of course most important, and if a man knows how to tell ordinary pneumonia or bronchitis, and finally arrives by elimination to the conclusion that he is dealing with tuberculosis, he is getting instruction in tuberculosis, although it may not be so designated.

With regard to hospitals, we have in our city one big charity hospital. We have one department in which tuberculous individuals are received up to the capacity of the wards. The only thing that keeps any person out of this hospital is the fact that the room which he would require is not available. I would like to know whether Dr. Smith objected absolutely to a hospital for tuberculosis being established as a unit per se—whether he thought it was detrimental to the cause of having patients received in general hospitals.

We are now working for the establishment of a hospital for the care of advanced cases of tuberculosis, whom I regard as the most potent factor in the spread of tuberculosis on account of the fact that they are in daily contact with children. I have had so much contact with tuberculosis that I believe adults have little to fear from it as far as getting infected is concerned. The ones we must protect are the children, and to permit the tuberculous father or mother to remain in daily contact with these children is certainly a very dangerous procedure to be permitted to continue. I regard tuberculosis as a good many persons with whom I have had conversation regard it, as a question of repeated, constant, large dosage, implanted on soil that is susceptible. When the soil is improved in resistance or when the amount of dosage is decreased, we have hope of the amelioration of infection, and that is one of the great big things for us to strive for. By corralling, by segregating those people who are adding millions and millions of bacilli per day where they will be potentially dangerous is the quickest method to relieve the situation. You can do that a good deal quicker by concentrating on that point and by establishing a hospital for that purpose than by trying to overload a general hospital with poor facilities for the care of the patient.

Dr. Lumsden. The conference has been very generous to me in time, but I can not refrain from rising at this point in the conference to express my personal appreciation of the gospel of hope which Dr. Smith has preached consistently and persistently to the tuberculous patient. About 1907 one of Dr. Smith's fellow workers in the Public Health Service had active tuberculosis. He consulted a number of learned doctors and the advice generally was to go to New Mexico, go to Arizona, go to Colorado, go to California, or go somewhere. This patient fortunately came under the judgment of Dr. Smith and Dr. Smith said, "Stay home and go on with your work, increase your rest, increase your food, properly and legitimately, and go on with your business." That man followed Dr. Smith's advice and he made an apparently complete recovery. I am glad, as I believe many other ex-tuberculous patients in the United States are, to indorse the encouraging and logical principles which Dr. Smith advocates.

Dr. Leathers. There is just one point I wanted to make and that is I do not believe that Dr. Smith is in any sense incorrect in regard to his statement relative to the training of physicians in the diagnosis of tuberculosis. During the last session of the Mississippi Legislature we secured about a million and a half dollars for tuberculosis, and we are trying to develop a sanatorium for the treatment of the patient and the instruction of the physician. We have the point of view that this institution will be a school of instruction rather than one of treatment. We feel we want our tuberculous population educated in the proper way to care for themselves and our physicians educated in the care of the cases through this institution. The superintendent of that institution has had tuberculosis, and he has had considerable opportunity to observe the training which has been received by medical students and physicians at the various medical schools and he tells me that practically all of the physicians with whom he deals have scarce the ability to diagnose tuberculosis at the proper time, which is of course in the early stages. Even though these students get a certain kind of training which doubtless is good training in that particular subject at the same time the outstanding fact exists that these students who come out of medical schools have certainly not been trained exactly along this line and they are not competent to diagnose tuberculosis—and that is the point which I think Dr. Smith intended to emphasize. The course in diagnosis does not seem to fit the men properly in diagnosis of this disease, regardless of all the efforts made and training in this subject. So far as the problem of tuberculosis is concerned, the most serious difficulty is to train the physician now practicing in the diagnosis of the disease at the proper stage.

Dr. **Snow.** I come from along back in that stage of this conference of the embalming discussions and of those old faces which Dr. Kerr sees here, and I think it would interest some, certainly myself, to get Dr. Fulton on his feet. From his wide experience and wide observation of this movement all over the world I feel we would benefit by his comments on Dr. Smith's paper.

Dr. **Cumming.** Dr. Fulton is one of the pioneers, although he is such a young man, in this fight against tuberculosis.

Dr. **Fulton.** I thank you very much for the compliment implied, and I will thank you more kindly when you give me permission to sit down.

I do not consider myself in any way qualified to discuss Dr. Smith's paper which concerns itself with the education of men with a higher amount of knowledge concerning tuberculosis than they seem to get under the present conditions. I think that it would be necessarily adding very much to what is already a very heavy load carried by all medical schools which attempt to teach a man in four years to be an average good, all-around physician. The tendency to specialize has been emphasized in the course of the discussion and has even been criticized, and I think quite rightly so. I can imagine the practical value in a full professorship of such a subject as tuberculosis. I can imagine a fairly good medical student, with the ordinary clinical facilities, getting through without having what is an essential knowledge of the diagnosis of tuberculosis, even a pulmonary tuberculosis, in the relatively early stages. If you want to make a diagnosis of that sort that is complete, conclusive, and quantitative, it is quite an undertaking. All that most medical schools can be expected to do is to bring a man to the point where he will be able to see the probability that a patient has tuberculosis and will have the intelligence to make the further diagnosis. I think that is the case not only with the case of tuberculosis, but in other conditions, such as malignancy or diabetes, and understanding the multitudinous complications of medical education in these days I do not think they can be expected to send out a man who will be able to make a diagnosis of a nutritional disease, or many chronic diseases, which are in these days quite easily referred, even in cities of no great size, to specialists. The specialist is a very generalized modern production of medical education and perhaps we are overspecializing. I think that all the specialties bid, to quite an extent, to limit or cut down a man's field of activity. The practice of public health itself necessarily excludes a really all-round knowledge of medicine. You may have had it at one time. I used to imagine that I was qualified as an internist, in fact I was an internist, but I would be shocked to death if I was stopped to give aid on the street at the present time.

Dr. SMITH. Replying to the first inquiry, I would not like to be understood as disparaging the necessity of special institutions or specialists in tuberculosis. None of us here, of course, needs to be told that Tulane is one of the best medical schools in the United States. I think, however, that this is really an illustration of the reaction which we are going to get from medical schools, at first, but which I hope will be quite different from the response which they will give later.

If you will reflect you will see that tuberculosis, which ranks second only in importance in causes of death, which causes 160,000 deaths in the United States in a year and one-third of all the deaths occurring between 30 and 40, ranks a professorship. I hope that medical schools will overcome the irritation which they always evidence to further demands on their time and will see their way clear to grant professorships.

Dr. McLAUGHLIN. It seems to me that Dr. Smith brought out in his very sane and logical discussion of this subject two points, one of which attracted attention and one of which either escaped notice or was at least not discussed. The one as to medical education was discussed. The cold, hard facts are these: When you get out into the problem of handling tuberculosis as a problem, Dr. Smith is exactly right. Our preventive work is rudimentary. The other point is that we have got to do something besides hospitalize people to stop tuberculosis. The point which Dr. Smith brought out and which was not discussed is this: We have got to come to home treatment in tuberculosis. I feel I can say, particularly because of my experience here in Massachusetts where we have possibly a more advanced hospitalization program than in other States, where we have four State sanatoria, county institutions, and in each municipality of 10,000 or more a tuberculosis dispensary, that first the specialists were not available to make an early diagnosis; and the second point was that even if we had hospital beds, people would not come to them. There was a man in Boston, a pioneer in this work, by the name of Pratt, who conducted a class in home treatment and who had most remarkable results in the treatment of patients in their homes. They did as he told them, and were ready and willing to do as they were told. To my mind, Dr. Smith stated very clearly, and it escaped observation or at least escaped discussion, that we have got to have some system of treating people in their homes and not transporting them even a distance of 50 miles.

Dr. Carey. We in Massachusetts have hospitals for tuberculosis and medical schools with a full professorship in tuberculosis. We have not, up to the past year, been able to get the medical men of Massachusetts thoroughly interested in tuberculosis, but we have started a campaign which we believe will interest them, which will educate them, and which ought to produce tremendous results. We have 4 State sanatoria and 6 county institutions and 20 municipalities of 50,000 or thereabouts maintaining hospitals, and 54 clinics or dispensaries with more or less adequate nursing service. We are convinced that future advancement in tuberculosis work will be in three main groups. First, that we must interest and teach the general practitioner methods of modern tuberculosis control, and we started our plan in the following way: We have chosen 16 dispensaries in various sections of the State to which a member of our tuberculosis staff at one of our sanatoria will make a visit each week. Secondarily, Dr. Champion's division of hygiene is intensifying on nutritional work. Third, my corps of district health officers and nursing assistants are intensifying on field investigation. It appears that we are making progress and we are approaching the proper solution of the tuberculosis problem in Massachusetts. I was a little amused at Dr. Leathers's statement that he was going to teach people how to take care of themselves in his sanatoria. We have people in our sanatoria that have been there for years, and it is a tremendous mistake, but it is almost impossible to get people out of a sanatorium if they are willing to stay there. Certainly the function of a sanatorium should be to teach the individual how to take care of himself and then take him home and see that he does it.

SOCIAL SERVICE IN PUBLIC HEALTH WORK.

(Dr. Dowling read the following paper:)

I think that in all efforts to control disease the sociological aspects have received a comparatively small amount of attention. The medical end of disease prevention I recognize as of paramount importance, but without more adequate social control it is difficult to see how results can be made permanent. This, I believe, applies especially to venereal work, the medical aspect of which is virtually complete in the majority of States. We all recognize the necessity for apprehension and control of the disseminator of syphilis and gonorrhea, but so far these efforts have been directed toward the apprehending and examination of infected men and women, principally women, and then after a course of treatment, which is supposed to render them harmless, they are allowed their freedom. How about those who come to the clinics and undergo treatment for a varying period? They are allowed to do as they please. Aside from a few leaflets, little, if any, instruction is given them in the nature and cause of syphilis and gonorrhea. No one goes to their homes to find out what conditions obtain in the family, whether or not there are young children living in intimate contact with the infected ones who may suffer innocently. Nor is the bearing of a syphilitic infection on the health and happiness of future generations explained to adults. Nothing short of a properly organized follow-up system can clinch the results of medical treatment. I regard it as a very necessary adjunct.

Another phase of medical work in which the social worker must inevitably occupy a very prominent place is in the handling of drug addicts. I need not tell you that a man or woman taken off his or her drug is not cured in the hospital. The moral fiber and the depleted resistance to temptation, as well as the individual's stamina and tendency to relapse at the first encounter with life's difficulties, must be rebuilt on a firm foundation. This takes patience and time, and it takes people with tact and energy and devotion to what must often appear a hopeless task. The educated social worker in a follow-up system is the only person peculiarly fitted for such purpose. He is a necessary adjunct, if this kind of work is not to be a dead failure.

It is not casting any reflection on State boards of health or the Public Health Service to say that their work has been conservative. Logically, the work of the latter is largely medical. The service has had a corps of devoted men whose research is of incalculable benefit, and whose instruction to the people with health propaganda has been excellent. State boards have done good work in education as well as other lines. But an adequate follow-up system to keep up the popular interest and to stimulate individual effort is of equal importance. It is quite possible that the best results can be obtained by closer association with organizations whose main efforts are directed along sociological and public welfare lines. I think that a mutual understanding can be reached through the exercise of perfect frankness on both sides, for mutual and popular benefit. Only by such cooperation and correlation of effort can the results of medical work be made a lasting boon to humanity.

Dr. LUMSDEN. Dr. Dowling's paper was so succinct that I am not sure I grasped fully the argument made in it. I have been under the impression that there is some difficulty in separating public health service from social service. When Dr. Dowling spoke of the necessity of having social service follow up the health service I wondered if in Louisiana those engaged in the health service do not consider the social conditions, and the economic conditions, and the religious conditions, and the educational conditions obtaining in the homes to which the health service is extended and carry out a follow-up system of health service including the social and economic aspects. I expect Dr. Dowling in his splendid public health work in Louisiana has done perhaps as much on the social side as he has on the strictly scientific, medical, or public health side in getting his results. I can not conceive of health service obtaining important results under any circumstances unless that health service be conducted in part as a social service. When we go to the home of the individual, and that is the place the work is really done in health service, or social service, or religious service, we must consider the social conditions in that home, we must appeal to the social sense of the person to whom we talk in order to expect a result from a public health standpoint. Because, make it as technical as we may, invoke the strong arm of the law as the State or local government may under its police power, the real result of health work is education. We appeal to the common sense and judgment of the individual to bring about a change in the social condition affecting him, or her, or the household, which will carry out that greatest of all doctrines, that greatest of all principles of ethics, handed down by the greatest of all teachers of public health and of social service, "Do unto others as you would they should do unto you."

PROPOSED LEGISLATION.

Dr. Cumming. Does anyone care to take up any phase of proposed legislation, which I think was discussed in conference before, informally?

I hope that the medical officers and State health officers who attended this conference have gotten as much pleasure and as much profit out of it as I have, and as I am sure the other officers of the Public Health Service have. To me it has been the most profitable meeting which I have had the pleasure of attending, and I hope we shall all be together at the next session.

Dr. Dowling. I have attended many meetings and we have had people show us courtesies and attentions in a number of places, but I want to offer a vote of thanks to the Massachusetts Department of Health, to Dr. Gallivan and Dr. Carey who have both been most courteous and attentive to us all during the meeting, and to the stenographers. They have all put themselves to a great deal of trouble for us.

Dr. Cumming. The Federal Government is under extreme obligation to Massachusetts and its officials and to the city officials for the courtesies shown during the meeting. If I may, I will put this to a formal vote. [Rising vote.]

I now declare the Nineteenth Annual Conference of State and Territorial Health Officers with the United States Public Health Service closed.

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

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DECEMBER, 1921

TRANSACTIONS OF THE FIRST ANNUAL CONFERENCE OF STATE SANITARY ENGINEERS

HELD AT WASHINGTON, D. C.
MAY 25, 1920

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FIGURE 1.—Typhoid fever death rates in New York State since 1885 ---- 7

FIRST ANNUAL CONFERENCE OF STATE SANITARY ENGINEERS.

TRANSACTIONS.

The First Annual Conference of State Sanitary Engineers was held in Washington, D. C., May 25, 1920.

The following persons were present at the conference:

Alabama.—G. H. Hazlehurst, State sanitary engineer.

Arkansas.—M. Z. Bair, State sanitary engineer.

Connecticut.—J. Frederick Jackson, State sanitary engineer.

Florida.—George W. Simons, director, bureau sanitary engineering, State board of health.

Illinois.—Harry F. Ferguson, chief sanitary engineer.

Indiana.—John C. Diggs, State sanitary engineer.

Kansas.—C. A. Haskins, director, division of water and sewage, State board of health.

Kentucky.—A. E. Gorman, State sanitary engineer.

Louisiana.—John H. O'Neill, State sanitary engineer.

Maryland.—Abel Wolman, division engineer, State department of health.

Michigan.—E. D. Rich, State sanitary engineer.

Minnesota.—H. A. Whittaker, director, division of sanitation, State board of health.

New York.—Theodore Horton, director, division of sanitary engineering, State department of health.

North Carolina.—H. E. Miller, director, bureau of engineering and inspection, State board of health.

North Dakota.—Isador W. Mendelsohn, State sanitary engineer.

Pennsylvania.—C. A. Emerson, jr., chief engineer, division of engineering, State department of health.

South Carolina.—E. L. Filby, State sanitary engineer.

Tennessee.—C. N. Harrub, State sanitary engineer.

Texas.—V. M. Ehlers, State sanitary engineer.

Virginia.—Richard Messer, State sanitary engineer.

United States Public Health Service.—Associate Sanitary Engineer Sol Pincus.

FIELD OF COOPERATION AMONG STATE SANITARY ENGINEERS.

V. M. EHLERS,
Chief Sanitary Engineer, Texas State Board of Health.

In these days of progress and accomplishment, cooperation and unity of purpose have been deciding factors to success. Captains of industry as well as the knights of labor recognize in cooperation and union the signposts that direct the way to the goal of attainment.

The proposition of cooperation among State sanitary engineers was seriously discussed, probably for the first time, during the convention of the American Public Health Association at New Orleans, in December, 1919. A number of State sanitary engineers were in attendance at this conference and several meetings of these men were held at which the general situation was discussed. A temporary organization, composed of all present at the time, was formed. Possibly the first important matter to consider is to make this temporary organization permanent. After this association has been perfected, actual work can proceed in a more systematic and orderly manner.

The field of proposed cooperation covers the entire sphere of activity of the State sanitary engineer. While it is true that some of the problems confronting us down in the South are not as pertinent in the Northern States, the fact remains, nevertheless, that mutual good could be accomplished by comparison of methods practiced and results obtained. Nearly all really important propositions have a close sectional corelationship.

The most difficult task that confronts the State sanitary engineer is, without doubt, the treatment and disposition of domestic and industrial wastes. Various methods are used to dispose of the garbage and other collected wastes. Quite a number of types of incinerators and reduction plants are in use—some of them operate more satisfactorily than do others. Models of sanitary toilets exist by the score. Some of these function less satisfactorily than do the others. The same may be said of residential sewage disposal plants.

Most States have laws regulating the purity of the effluent from sewage treatment plants and describe and direct methods for the disposal of this effluent. Analytical methods employed vary very much indeed.

The problem of determining what constitutes stream pollution is a most vexing one, in my opinion, and can be settled only after a thorough and exhaustive study of the subject in all its phases, and could best be accomplished by a committee of sanitary engineers. This question is especially important when the pollution of a stream flowing through several States is considered. It is highly essential that uniform standards clearly defining such contamination be worked out and adopted. In this connection it would also be desirable that we use our concentrated efforts to the end that uniform State laws be promulgated covering and regulating this feature of sanitation.

Uniformity in rat-proof construction of docks, loading platforms, and guards in the various coastal States is needed.

It would also appear timely and proper to make a study of the construction and sanitation of dairies, municipally and privately owned abattoirs, ice factories, and similar industries, with a view to standardizing the sanitary features necessarily a part of plants of this character.

Purification of water is another problem probably given more general study and attention than any other in the field of sanitary engineering, and justly so, because upon the purity and wholesomeness of our water supplies depend directly the health and welfare of our citizens. The occasion for adopting stringent measures to safeguard the sources of our water supplies is urgent and universal. Many States have already adopted regulations that are very beneficial and far-reaching in the endeavor to bring about the desired result.

In recent years much serious thought has been given to the study of sanitary drinking fountains and a great many sanitary fountains have been placed upon the market.

Artificial swimming pools may be found in many communities. Some of the pools are insanitary, and instead of aiding and improving the health of the bathers may at times become a distinct menace to the patrons. Sanitation of swimming pools is a crying need. Strict regulations governing the construction and operation of these installations should be worked out and urged for adoption by the State boards of health.

One of the really serious conditions confronting the Nation at this time and one which is rapidly becoming worse is the housing problem. A combination of circumstances has brought about a situation which is well-nigh intolerable. Apparently no relief is in sight in the immediate future. Action tending toward the alleviation of conditions is imperative. Under this subject may also be considered plumbing, heating, lighting, and ventilating. Each of these are of great importance and will become more so as our population increases.

Sanitation of public buildings, such as jails, theaters, and schools, is a matter with which all State sanitary engineers have been directly concerned for some time. The authority granted the State officials for the proper control and regulation of these institutions should be amplified and more clearly defined.

Another problem directly affecting the Southern States, and in a lesser degree the North also, is mosquito control. Several of the Southern States in which malaria is prevalent have made wonderful progress toward the eradication of the mosquito. A comparison of methods pursued and results obtained would produce some valuable information for those now engaged in the work.

Other problems requiring further detailed study and thorough investigation by sanitarians are practical control measures of pellagra and hookworm.

The foregoing may be considered as a brief and rather incomplete outline of the field of activity of our State sanitary engineers. That much good could be accomplished through cooperation among these engineers there can be no doubt. The question then resolves itself into the proposition of deciding which would be the best method of procedure to obtain the desired result.

The United States Public Health Service, as we all know, has been of great value to us in lending us material aid and assistance in furthering our work in the several States. Our aims and ambitions are very closely related. It therefore occurred to the writer that the United States Public Health Service might be induced to detail a sanitary engineer who would act as whole-time secretary of this organization. It is our opinion that a capable man's time could hardly be spent to better advantage. The secretary's office would be a sort of a clearing house for reports of special committees appointed to make investigations and recommendations concerning the various problems confronting our organization. Individual members would also report on work accomplished, together with their personal suggestions and recommendations to bring about improvements. Copies of all meritorious reports could be submitted to the various members, so that every one would at all times be in touch with everyone else individually and with the association as a whole. It might also be advisable for the organization to publish an abstract journal in which articles of interest to members could be abstracted. The articles themselves could be furnished to interested members on application to the secretary.

In connection with these regular duties mentioned, the secretary might keep a list of sanitary engineers available as assistants, city sanitarians, or for similar positions, and upon application by a member, furnish him with names and qualifications of men available.

It is our opinion that if a scheme of procedure similar to the one outlined is adopted and put into effect, not only will the science of sanitary engineering be greatly benefited but valuable service will be rendered the citizens of this country.

THE INFLUENCE OF ENGINEERING WORK OF PUBLIC HEALTH DEPARTMENTS IN THE REDUCTION OF MORTALITY.

THEODORE HORTON,
Chief Engineer, New York State Department of Health.

It would be difficult indeed to measure with any degree of accuracy the influence which sanitary engineering work exerts upon the reduction of disease mortality. This is obviously due to the fact that in the field of public health there are no sharply defined lines which separate the work of the engineer from that of the chemist or the biologist or the physician. Generally speaking, these professional experts all work in more or less close cooperation, attacking the same great problem of life-saving merely from different angles or strategic points, leaving the question as to the share which each contributes individually to the whole, a somewhat ill-defined and indeterminate one.

On the other hand, the work of the engineer in this field is perhaps more sharply defined and more exclusive in character than the work of any other profession. This is particularly true with respect to certain activities, such as the supervision of public water supplies, the extermination of mosquitoes, the abatement of nuisances, and the supervision of milk pasteurization. Again, some of these activities, such as the supervision of public water supplies and the extermination of mosquitoes, are associated directly and exclusively with certain specific diseases, such as typhoid fever, cholera, malaria, and yellow fever; and it is obvious that any reduction in mortality from these diseases may, within certain limits, very properly be used as a measure of the effect and value of these lines of engineering work. Other activities, however, such as the abatement of nuisances, or the examination of sewerage plans, are only indirectly associated with disease transmission, and for this reason any measure of the effect and value of these lines of work, based upon a comparison of mortality rates, becomes difficult, if not impossible.

When, therefore, we attempt to use mortality rates to measure the effect of any particular engineering activity, considerable care must be exercised; and two points in particular should be borne in mind. One is that there may be other sources or agents of infection responsible for the particular disease whose mortality rates are being compared than those directly associated with the particular engineering activity in question. The other is that in addition to the preventive measures carried on through any particular engineering activity, there may have been other corrective measures taken, such as immunization and medical treatment.

As an illustration of both of these factors we may take the case of typhoid fever. This disease, as you all know, may be caused not only by infected water, a strictly engineering factor, but also by infected foods, carriers, and contact infection, factors not usually associated with engineering work. Unless, therefore, vital statistics are carefully recorded, or other epidemiological evidence is available indicating the proportion of infection due to impure water supplies as compared with infection due to other factors, one may readily be misled in crediting a declining death rate from this disease to engineering activities. Or again, taking the same disease, it is possible that with effective typhoid vaccination, as practiced in military service and to a limited extent elsewhere, a low death rate from this disease may be attained largely independent of the purity of water supplies. Unless we know how extensively this immunization treatment is practiced we may again be misled in our conclusions.

Fortunately a number of our States have kept very complete statistical and epidemiological records covering a considerable period of years, and these indicate quite clearly the extent to which the typhoid fever rate has been lowered through improvements in public water supplies. The experience in New York State is particularly interesting, for in this State not only has unusual care been taken in reporting vital statistics, but for many years the engineering division, in addition to its work of supervision over public water supplies, has had charge of all epidemiological investigations with reference to this disease. The story may best be told perhaps by the accompanying chart and table, one showing the typhoid fever rate in the State from 1885 to date, and the other a list of cities of the State with the typhoid rates before and after the installation of water purification plants or other improvements.

You will note from the chart, showing the typhoid fever rate for the State, that the curve may be divided into two distinct portions or periods, one prior to the year 1907 and the other subsequent to 1907, the two portions of the curve being quite dissimilar in some respects and indicating clearly the influence or relation which engineering work has had in reducing the prevalence of this disease. The sanitary engineering division was established in 1906. Prior to this year there was no systematic supervision whatever over the water supplies of the State, and by observing the character of the curve for this earlier period you will note that the typhoid fever rate is not only very irregular, but excessive, averaging about 23.1 for 100,000, and reaching a maximum of 30 in 1891.

In contrast with this portion of the curve, note the portion subsequent to 1907, during which the engineering division has been constantly and actively engaged in work of investigation and supervision of the public water supplies of the State. You will observe that from the very beginning of this period the typhoid fever rate has uniformly and progressively declined, with only a slight deviation from a straight line, and with almost phenomenal rapidity,

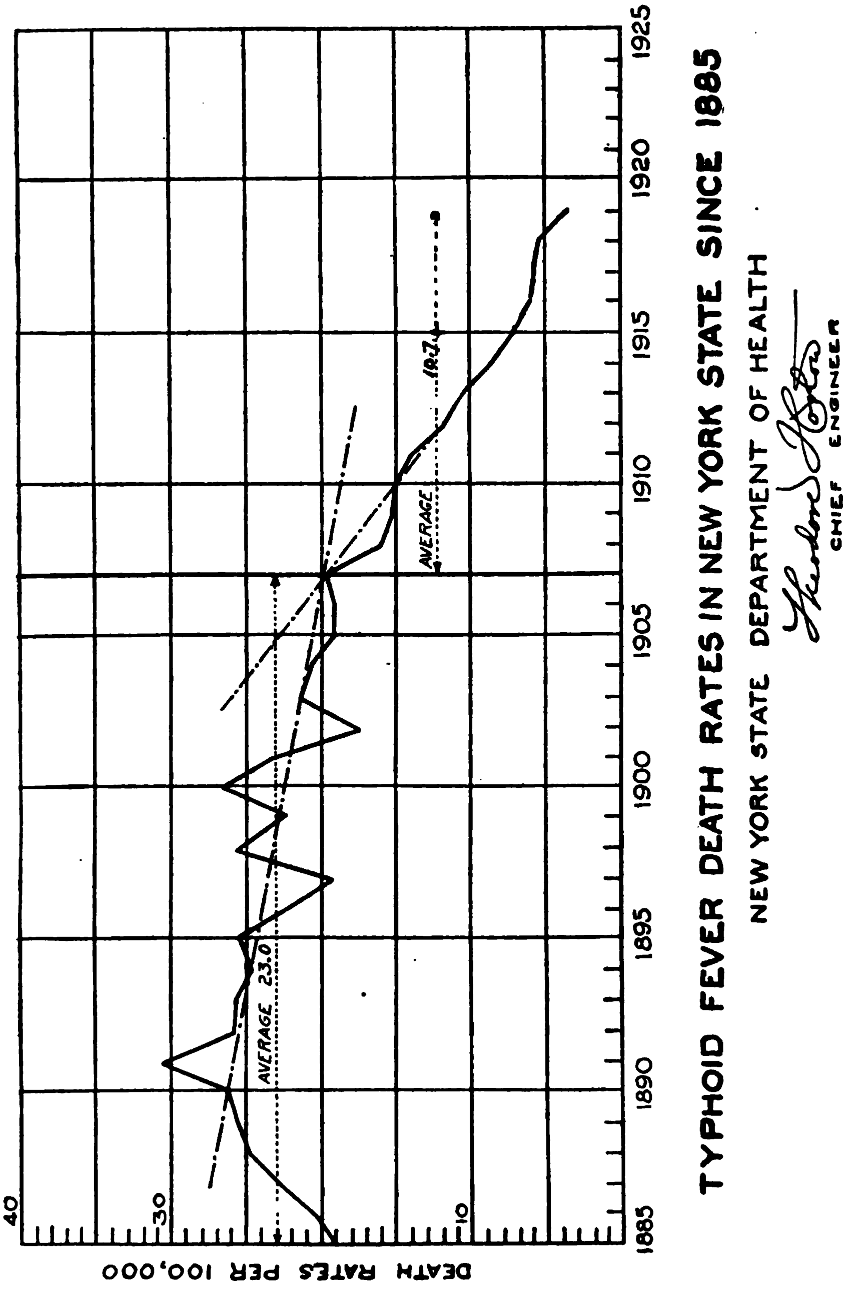

FIGURE 1.

reaching the very low rate of 3.3 per 100,000 in 1919. This rapid decrease in the typhoid fever rate subsequent to 1907, as compared with the decrease prior to 1907, corresponds numerically to a saving of some 7,000 lives during this 12-year period, a rather striking indication of the extent and value of this particular life-saving work.

While the circumstantial evidence presented by this chart indicates that this rapid lowering of the typhoid-fever rate in New York State is due primarily to engineering work of supervision of public water supplies, this evidence is quite clearly confirmed by the evidence furnished by the table (pp. 9–13), which shows for each of the cities of the State the typhoid-fever rates before and after the introduction of water purification. You have only to glance down this list to see that in nearly every instance the rates have dropped almost immediately following the introduction of these improvements, and that by no possible coincidence could any other reason than purification or other improvements in these supplies be responsible for the sudden lowering of these typhoid-fever rates.

The influence of other possible causes of this rapid decline in the typhoid rate of the State must, of course, not be overlooked; and here statistical and epidemiological records bear out our conclusions. The use of typhoid vaccine has been resorted to to only a very limited extent in the State, and the influence of this factor has been almost negligible. Milk and other food epidemics have been few, and the typhoid rate from this cause has been insignificant in comparison with the total typhoid rate for the State. Typhoid carriers have been apprehended in a number of cases, but the total of their influence has been very small. Secondary infection has been, and will probably continue to be, an important factor, but we must bear in mind that these secondary cases are secondary to primary ones and must be logically classed with them.

Briefly, our experience in New York State, based on statistical and epidemiological records, has clearly demonstrated that typhoid fever has been, and is still, largely a water-borne disease; and that only through careful supervision of public water supplies, prompt investigations of outbreaks and the immediate application of remedial measures, while these outbreaks are in their incipient stages, has it been possible to reduce the typhoid rate to almost a negligible figure.

While typhoid fever and cholera hold first place among the diseases which are rapidly being eradicated, largely through the influence of engineering activities, there are two others which may be considered close seconds, viz, malaria and yellow fever. These diseases may both be considered largely tropical, though even as far north as New York State malaria has been, and is still, a factor, and in order to control it we have in force one of the most effective mosquito-extermination laws in the country.

Water supply and typhoid fever in the cities of New York State.

City and population. (State census of 1915.)	Source of water supply.	Present treatment.	Remarks.	Typhoid fever death rates. (Average annual deaths per 100,000 population.)							
				Before improvement in water supply.		After improvement in water supply.					
				Years.	Average.	Years.	Average.	1901–1905	1906–1910	1911–1915	1916–1918
Albany (107,979)	Hudson River	Prefilters, slow sand filters, and sterilization.	Sand filters installed 1899; prefilters installed 1908; hypochlorite plant installed 1909.	1889–1899	88.8	1900–1918	18.7	21.8	17.0	18.8	10.2
Amsterdam [1] (34,319)	Hans Creek and Steele Creek with large reservoirs.	No treatment	Progressive improvement, two small polluted streams abandoned, 1910.	1898–1910	28.8	1911–1918	8.0	23.8	14.9	11.0	2.9
Auburn [1] (32,468)	Owasco Lake	Sterilization	Hypochlorite apparatus installed 1911; liquid chlorine treatment since 1913.	1898–1910	20.7	1911–1918	14.1	20.6	18.2	14.3	14.0
Batavia [1] (13,278)	Tonawanda Creek	Mechanical gravity filters and sterilization.	Filters and liquid chlorine installed 1917.	1898–1916	30.1	1917–1918	21.2	36.9	31.0	16.5	13.4
Beacon [1] (10,825)	Surface streams; auxiliary supply from Fishkill Creek.	Auxiliary supply sterilized when used.	Liquid chlorine plant installed in 1914.	1913–1914	9.0	1915–1918	4.8	......	......	29.2	3.1
Binghamton (53,668)	Susquehanna River	Mechanical gravity filters, sterilization.	Filters installed in 1902, hypochlorite.	1889–1902	50.3	1903–1918	11.6	22.2	13.6	12.0	8.5
Buffalo (454,630)	Lake Erie	Sterilization	Liquid chlorine plant installed 1913.	1901–1913	24.1	1914–1918	11.2	29.2	23.3	15.6	9.7
Canandaigua (7,501)	Canandaigua Lake	No treatment	......	......	......	......	......	34.4	38.5	21.7	22.0
Cohoes [1] (23,433)	Mohawk River	Mechanical gravity filters and sterilization.	Filters and hypochlorite apparatus installed in 1911.	1888–1911	84.8	1912–1918	19.9	89.4	71.4	45.3	8.6
Corning [1] (13,459)	Dug well	Sterilization	Liquid chlorine plant installed 1915.	1898–1915	42.7	1916–1918	32.3	38.4	52.2	25.4	32.3
Cortland [1] (12,367)	do	No treatment	Gradual improvements to protect well.	......	......	......	......	32.4	28.6	18.5	9.8
Dunkirk [1] (17,870)	Lake Erie	Sterilization	Liquid chlorine plant installed May, 1914.	1898–1914	34.5	1915–1918	9.8	43.7	29.7	31.8	7.5
Elmira [1] (40,073)	Chemung River	Mechanical gravity filters and sterilization.	Filtered since 1896; hypochlorite used since 1911.	1888–1896 1897–1910	53.8 39.2	1911–1918	12.7	45.1	32.8	12.1	13.7
Fulton [1] (11,138)	Dug wells	No treatment	Gradual improvements to eliminate surface water and Oswego River water.	......	......	......	......	37.3	17.6	25.2	14.6

[1] Improvements in the public water supply made following investigations and recommendations of the department.

Water supply and typhoid fever in the cities of New York State—Continued.

City and population. (State census of 1915.)	Source of water supply.	Present treatment.	Remarks.	Typhoid fever death rates. (Average annual deaths per 100,000 population.)							
				Before improvement in water supply.		After improvement in water supply.					
				Years.	Average.	Years.	Average.	1901–1905	1906–1910	1911–1915	1916–1918
Geneva [1] (13,232)	Seneca Lake	Slow sand filters	Filters installed 1914	1898–1913	31.3	1914–1918	17.8	36.4	20.1	31.2	17.2
Glens Falls (16,323)	Surface streams and storage reservoir.	No treatment	Rules and regulations enacted 1912.	....	.....	....	.....	35.0	30.8	17.5	13.9
Gloversville [1] (21,178)	Surface streams and storage reservoirs.	Sterilization apparatus to be installed.	More effective patrol since 1912.	....	.....	....	.....	18.5	13.6	10.3	3.1
Hornell [1] (14,352)	Seeley Creek	Mechanical pressure filters and sterilization.	Filters installed in 1899; water supply rules enacted 1913; liquid chlorine plant installed 1915.	1890–1899	55.0	1900–1918	17.3	31.6	17.4	10.0	2.3
Hudson (11,544)	Taghkanic Creek and Churchtown Reservoir.	Slow sand filters	Filters installed in 1874; Hudson River source abandoned 1905; liquid chlorine 1914.	1898–1904	78.6	1905–1918	25.4	73.8	25.4	28.5	17.3
Ithaca [1] (16,750)	Six Mile Creek	Mechanical gravity filters and sterilization.	Filters installed in 1903 following typhoid epidemic; hypochlorite used since 1914.	1898–1903	78.4	1903–1915	17.3	90.1	15.2	23.1	11.6
Jamestown (37,780)	Driven wells	No treatment	....	....	.....	....	.....	27.9	23.1	14.3	5.0
Johnstown [1] (10,688)	Surface streams	Sterlization	Liquid chlorine installed 1918	....	.....	....	.....	12.1	10.2	7.5	0.0
Kingston [1] (26,354)	Sawkill Creek	Mechanical pressure filters and sterilization.	Filters installed in 1898; hypochlorite plant installed in 1912.	1898–1911	19.6	1912–1918	21.7	18.2	23.1	19.9	26.5
Lackawanna [1] (15,737)	Lake Erie	Sterilization	Liquid chlorine plant installed in 1913.	1909–1913	4.3	1914–1918	3.9	.....	.....	5.0	2.1
Little Falls [1] (13,022)	Surface streams	Slow sand filter for portion of supply. Sterilization.	Liquid chlorine plant installed in 1916.	1898–1916	26.4	1917–1918	30.0	26.0	19.2	17.2	22.5
Lockport [1] (18,693)	Niagara River	Sterilization	Source changed in 1909 from Erie canal to Niagara River; liquid chlorine plant installed 1913.	1898–1908	57.2	1909–1913 1914–1918	33.2 19.9	53.8	47.8	33.1	28.1
Mechanicville (8,208)	Surface streams	Supply partly filtered in slow sand filter.	Filter installed in 1909	1901–1909	19.9	1910–1918	15.7	29.6	12.3	7.9	24.0
Middletown (17,381)	do	Mechanical gravity and pressure filters.	Filters installed in 1900	1894–1900	31.0	1901–1918	24.1	26.2	24.8	28.5	11.9

Mount Vernon[1] (37,583).	.....do.	Slow sand and mechanical pressure filters and sterilization.	Filters installed 1894; hypochlorite used since 1909 for Mamaroneck River source; liquid chlorine plant recently installed.	1898-1908	14.7	1909-1918	8.2	14.3	16.2	8.9	6.8
Newburgh (27,876).	Silver Creek and Washington Lake.	Sterilization.	Hypochlorite used since 1914; liquid chlorine since 1916.	1898-1913	38.4	1914-1918	17.1	36.9	41.8	29.6	16.7
New Rochelle[1] (31,758).	Surface streams and driven wells.	.....do.	Hypochlorite used since 1913.	1898-1913	16.6	1914-1918	4.9	24.9	20.1	6.8	3.0
New York City[2] (5,468,190).	Croton River, Bronx River, Byram River, surface streams, and driven wells.	.....do.	Hypochlorite plant installed in Croton aqueduct 1912; liquid chlorine treatment used since 1916.	1901-1912	15.1	1913-1918	5.6	18.1	14.0	8.1	4.3
Niagara Falls[1] (42,257).	Niagara River.	Mechanical gravity filters and sterilization.	Water company supply and municipal supply filtered since 1912; water company supply partly filtered prior to 1912; hypochlorite treatment of municipal supply; liquid chlorine treatment of water company supply in each case since 1912.	1898-1911	128.4	1912-1918	19.8	145.1	108.1	60.4	8.0
North Tonawanda[1] (13,498).	.....do.	Sterilization.	Liquid chlorine plant installed Nov., 1914; poorly operated.	1898-1914	36.8	1915-1918	27.0	32.1	43.7	45.2	26.1
Norwich (8,342).	Chenango Lake and surface streams.	Mechanical pressure filters and sterilization.	Filters installed in 1905; hypochlorite plant installed later.	1901-1905	11.9	1906-1918	7.6	11.9	0.0	17.5	3.8
Ogdensburg[1] (14,338).	St. Lawrence River.	Slow sand filters.	Filters installed in 1913 and source changed from Oswegatchie River.	1898-1912	50.0	1913-1918	17.8	55.5	41.1	23.4	19.1
Olean[1] (17,925).	Driven wells and Olean Creek.	Sterilization (wells). Gravity mechanical filters and sterilization.	Liquid chlorine for wells 1918; Olean Creek supply first used 1919.	....	......	....	......	20.4	14.5	11.2	3.4
Oneida (9,461)	Surface stream.	No treatment.	....	....	......	....	......	20.0	15.9	7.1	6.8
Oneonta[1] (10,474).	Oneonta Creek.	Mechanical pressure filters and sterilization.	Filters installed since 1906; hypochlorite treatment 1914.	1899-1906	35.8	1907-1918	28.0	36.3	48.2	19.4	15.5
Oswego[1] (25,426).	Lake Ontario.	Sterilization.	Oswego River source abandoned for Lake Ontario in 1910; hypochlorite treatment; liquid chlorine since 1917.	1898-1910	45.4	1911-1918	14.3	48.0	53.6	17.5	9.0
Plattsburg[1] (10,134).	West Brook and reservoirs.	.....do.	Hypochlorite plant installed in 1915; liquid chlorine since 1916.	1898-1915	25.6	1916-1918	34.5	21.1	21.9	37.1	34.5
Port Jervis[1] (9,413).	Surface ponds and streams supplemented by Neversink River.	Sterilization of Neversink River supply when used.	Hypochlorite treatment of Neversink River water, when used, since 1914 and liquid chlorine since 1916.	1898-1913	36.1	1914-1918	8.0	60.4	33.3	21.0	3.6
Poughkeepsie[1] (32,714).	Hudson River.	Slow sand filters and sterilization.	Filters installed in 1872, improved 1907; hypochlorite plant installed 1910; liquid chlorine plant installed 1913.	1898-1907	45.2	1908-1909 1910-1918	28.7 11.9	41.7	45.3	13.1	7.7

[1] Improvements in the public water supply made following investigations and recommendations of the department.

Water supply and typhoid fever in the cities of New York State—Continued.

City and population. (State census of 1915.)	Source of water supply.	Present treatment.	Remarks.	Typhoid fever death rates. (Average annual deaths per 100,000 population.)							
				Before improvement in water supply.		After improvement in water supply.					
				Years.	Average.	Years.	Average.	1901–1905	1906–1910	1911–1915	1916–1918
Rensselaer (11,210)	Hudson River	Mechanical gravity filters and sterilization.	Filters installed 1901; hypochlorite plant installed 1911; liquid chlorine, 1917.	1898–1901	102.6	1902–1910 1911–1918	46.1 6.8	62.3	33.0	7.4	5.9
Rochester (248,465)	Hemlock and Canadice Lakes.	Sterilization for Canadice Lake only.	Canadice Lake first used 1919.	....	.....	....	.....	13.6	13.0	9.5	3.3
Rome [1] (21,926)	Fish Creek	Sterilization	Source changed from Mohawk River to Fish Creek in 1909; liquid chlorine installed in 1916.	1898–1909	23.0	1910–1915 1916–1918	16.8 13.3	24.6	21.4	16.3	13.3
Salamanca (8,370)	Springs and driven wells	No treatment		....	.....	....	.....	12.4	27.0	9.8	10.9
Saratoga Springs [1] (13,792).	Loughberry Lake	Sterilization	Liquid chlorine installed 1919; more effective patrol since 1914.	....	.....	....	.....	40.1	23.3	30.1	18.7
Schenectady (80,381)	Large wells intercepting ground water flow to river.	No treatment	Use of Mohawk River water discontinued 1903.	1890–1903	86.0	1904–1918	9.5	26.2	11.0	8.1	5.2
Syracuse (145,293)	Skaneateles Lake	Sterilization	Liquid chlorine installed 1917; since 1906 watershed protected by revised rules more rigidly enforced.	1898–1906	19.7	1907–1916 1917–1918	13.9 8.7	14.4	14.9	12.2	10.1
Tonawanda [1] (9,147)	Niagara River	....do	Liquid chlorine plant installed August, 1919.	....	.....	....	.....	23.3	46.9	30.5	14.1
Troy (75,488)	Surface streams and lakes	No treatment	Partial use of Hudson River water discontinued 1906.	1898–1906	55.7	1907–1918	24.1	45.7	27.7	23.1	23.9
Utica [1] (80,589)	West Canada Creek and small surface streams.	West Canada Creek water sterilized since 1914.	Since 1906 watershed protected by revised rules more rigidly enforced.	1898–1906	18.2	1907–1914 1915–1918	11.6 9.0	16.0	17.1	7.8	10.9
Watertown [1] (26,895)	Black River	Mechanical gravity filters and sterilization.	Filters installed 1904, following typhoid epidemic; hypochlorite used since 1911.	1898–1904	94.9	1905–1911 1912–1918	46.5 16.1	81.2	50.9	18.1	19.8
Watervliet [1] (14,990)	Normanskill	....do	Source of supply changed to Normanskill 1918.	1898–1917	43.7	1918	20.1	56.6	32.5	49.8	20.1

White Plains (19,287)...	Driven wells, dug wells, and surface stream.	No treatment..............	Polluted wells abandoned and watershed improved about 1912.	....	......	....	......	9.5	14.9	14.6	1.6
Yonkers (90,913)........	Saw Mill, Sprain, and Grassy Sprain Rivers.	Slow sand filters and sterilization for Saw Mill River supply.	Two slow sand filter units installed in 1904; hypochlorite plant installed in 1910; two additional filter units installed in 1909 and two in 1915; liquid chlorine 1917.	1898–1904	11.8	1905–1909 1910–1918	7.2 8.0	11.2	10.6	8.5	3.5

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[1] Improvements in the public water supply made following investigations and recommendations of the department.

Annual typhoid fever death rates per 100,000 population in New York State, 1885–1915.

1885	19.0	1897	19.4	1909	15.1
1886	20.4	1898	25.6	1910	15.0
1887	22.7	1899	22.4	1911	14.0
1888	24.9	1900	26.7	1912	11.8
1889	25.6	1901	23.4	1913	10.5
1890	26.1	1902	17.4	1914	8.8
1891	30.5	1903	21.5	1915	7.7
1892	25.8	1904	20.9	1916	5.9
1893	25.7	1905	19.2	1917	5.7
1894	24.7	1906	19.0	1918	5.4
1895	25.4	1907	19.8	1919	3.3
1896	22.6	1908	16.0		

Typhoid fever death rate per 100,000 population in the cities of the State (combined population, 8,234,738) for 1918=5.1.

Since, however, these two diseases are comparatively negligible factors in the State of New York as compared with other States, and notwithstanding that effective and interesting work has been carried on in New York, particularly on Long Island, the speaker prefers to leave this phase of the subject for discussion by others who have a wider experience in localities where these diseases have been more prevalent. The speaker wishes to emphasize one point, however, viz, that although the general reduction of mortality from malaria must be shared partly with the medical profession, resulting from both immunization and curative methods, the ultimate eradication of this disease must obviously rest principally with the engineering profession, whose activities are directed primarily toward removing the cause or infective agents and whose work in this respect is more truly preventive and permanent than the work of the medical profession.

In the case of yellow fever, one of the problems, of course, is the elimination of the breeding places of the yellow fever mosquito around habitations. Although these water-borne and mosquito-borne diseases are the more important ones associated with engineering activities, the value of which may be largely measured in terms of decreasing mortality rates, there are other diseases whose declining mortality rates or ultimate eradication will undoubtedly more and more fall within the province of the sanitary engineering profession owing to engineering features involved. Furthermore, there are other engineering activities which, while not having a direct and measurable effect in decreasing the death rate, do, nevertheless, have an indirect effect.

In the control of such diseases as typhus fever and bubonic plague, the work of the physician will necessarily, or at least advantageously, have to be supplemented by work of the engineer. Whether it be the establishment and operation of fumigating stations, field work in eradicating the parasite of infection or transmission, or executive work in carrying out other protective or corrective measures, his services will, in the opinion of the speaker, be increasingly demanded, particularly as the value of engineering, administrative, and executive qualifications in these fields becomes better known and better appreciated.

In the second instance the speaker refers to certain strictly engineering lines of work which have an indirect effect in promoting health, or, conversely, in lowering the death rate. Without attempting to suggest a discussion of the Mills-Reineke-Hazen theories, we all recognize the fact that in furnishing pure water we not only eliminate water-borne diseases such as typhoid fever, cholera, and dysentery, but apparently contribute, in other ways not yet determined, to the good health and well-being of the community. We recognize, too, that the introduction of sewerage systems reduces opportunities for infection of wells; that purification of municipal sewage reduces dangers of infection from bathing and infection of milk from wading of cattle; that purification of water in swimming pools reduces the dangers of transmitting infections to bathers; that milk pasteurization, now a well-developed activity of engineering divisions in some States, reduces the mortality from milk-borne infectious diseases. In fact, we know that in all of these engineering activities just referred to there must result indirectly a material reduction of the general death rate whether we can differentiate and measure it by means of mortality statistics or not.

In conclusion, the speaker feels that as a higher efficiency is attained in methods of diagnosis and in the reporting and recording of vital statistics, a truer and more accurate index will be furnished of the influence which sanitary engineering activities exert in reducing the general death rate, and a greater appreciation given to the value of engineering services generally in the field of public health work.

STATE SANITARY CONTROL OF PUBLIC WATER SUPPLIES AND SEWERAGE SYSTEMS.

W. H. Dittoe,
Chief Engineer, Ohio State Department of Health.

The benefits to be derived from efficient control of sanitary improvements by State departments of health have been demonstrated by the experiences of a number of States in which such control has been exercised for varying periods of time. The results of such control have been shown to be of great value to the public, not only in accomplishing a marked reduction in mortality, but also in permitting the establishment of broad policies, adherence to which results in more complete and proper utilization of natural resources, as well as a considerable saving in cost of improvements. By placing such control in the hands of a central authority there has also been created a means for the collection and interchange of information helpful in connection with the installation and operation of sanitary improvements. I do not consider that it is necessary for me to present a plea for State control, and I shall therefore attempt to outline what in my opinion should be the extent, nature, and method of such control.

Three main features of control are necessary to accomplish adequate jurisdiction over sanitary improvements. The first and most important feature is enforcement of legislation requiring approval by the State department of health of plans for all improvements of a public or quasi-public nature involving water supply and sewerage. The second, and almost equally necessary, feature is legislation providing for State supervisory control of maintenance and operation of such improvements. The third necessary feature is legislation providing for the issuance and enforcement of orders by the State department of health requiring water supply and sewerage improvements which are necessary to protect the public health.

I shall endeavor to set forth briefly an outline of the more important considerations to be given to these three features:

APPROVAL OF PLANS.

The law should prohibit the installation of any improvement involving water supply or sewerage for public or quasi-public purposes until the State department of health has approved such proposed improvement or the plans and specifications therefor. While it is primarily necessary that such legislation apply to the municipalities and other centers of population, the broadest scope should include every possible place where the public can be served. This would comprise municipalities or parts thereof; unincorporated communities; water and sewer districts outside of municipalities; realty allotments; resorts, parks and camps; national, State, county, district, and municipal public institutions; privately owned institutions; universities, colleges, seminaries, schools, and other educational institutions; churches, hotels, clubs, and factories; steam and electric railroad stations and trains; and all other public and quasi-public places used for the assemblage or employment of persons. For such places the law should require the submission of plans covering the following classes of improvements:

1. New and additional water supplies and extensions and changes thereof.
2. Water filtration and treatment plants and extensions or changes thereof.
3. Waterworks systems and extensions or changes thereof, including installations for obtaining, pumping, storing and distributing the supply.
4. Sewerage, sewerage systems and extensions or changes thereof.
5. Sewage treatment and methods of sewage disposal and extensions and changes thereof.
6. Methods of treatment and disposal of industrial wastes and extensions and changes thereof.

It may be advantageous to mention some of the more important items which should be observed in passing upon plans submitted for approval. It is evident that all features should be carefully scrutinized which may have any bearing upon the safety and efficiency of the improvement from the standpoint of public health and sanitation. It is believed that the following general principles should be applied in considering proposed water supply improvements:

1. Dual water supplies should not be permitted, nor should a municipality be allowed to install a water supply, unfit for domestic use, with the proposal that the supply is for fire-protection purposes only. In other words, the public water supply should be one suitable for all uses, particularly drinking and domestic purposes.

2. No emergency water supply which is contaminated or subject to contamination should be permitted.

3. The adequacy of the proposed water supply and its development should be demonstrated beyond a reasonable doubt, taking into account the future requirements to be placed upon it. The supply and its development should be adequate to furnish not only the domestic demand but also all other legitimate demands for water, such as industrial consumption and fire protection, otherwise the use of an emergency supply is likely.

4. The quality of the water supply must be satisfactory and in addition to the hygienic quality, which is of prime importance, due consideration should be given to physical quality (color, odor, turbidity, taste), and to chemical quality (salinity, hardness, acidity, and iron). While the State department of health should not be charged with the control of other than sanitary features, it is pertinent to recognize that the standard of a public water supply demands a high scale of quality from all standpoints.

5. The development of the water-supply improvement must be safe. Due assurance must be had that the supply will be protected from surface and subsoil drainage, from flood water, and from contamination due to leakage into reservoirs and clear wells, and due to exposure in open reservoirs. The design of such purification processes as may be necessary should be in accordance with accepted practice and should be such as to give full assurance of the efficiency of the purification to be effected. By-passes for unpurified water should not be permitted.

6. As a whole, the works should be designed to facilitate maintenance and operation, as difficulties in operation frequently destroy efficiency. Unnecessary frills should be avoided.

In considering plans for sewerage improvements the following are some of the more important general principles:

1. The type of sewerage system should be selected to meet the local needs, considering the future development of the territory. While separate systems are applicable in practically every instance, this is not true of combined systems which are preferable only under certain circumstances.

2. The adequacy of the sewer design should be carefully analyzed, with due consideration of the period of design and of the assumptions used in forming a basis.

3. The suitability of details which may affect the maintenance and usefulness of the system should be studied with care, such details including hydraulic features, manholes, jointing, and other special features.

4. The purpose for which a sewage treatment plant is to be installed should be clearly understood and the required accomplishment of the plant should be determined as accurately as possible. Knowing these facts the adequacy of the plant to accomplish the results, should be carefully studied.

5. The design of sewerage systems and sewage treatment plants should be simplified to facilitate maintenance and operation. This feature is one of the most important ones to be considered in passing upon plans for sewage-treatment plants.

SUPERVISORY CONTROL OF MAINTENANCE AND OPERATION.

The law should require that the maintenance and operation of water supply and sewerage improvements of the classes previously described shall be satisfactory to and subject to control of the State department of health. It should also provide for the submission to such department of records maintained by the local authority. As local regulations are also necessary to insure proper maintenance and operation, there should be a means of State control of such local regulations in order to insure their applicability. Without attempting to discuss details of the method of accomplishing this result, I desire to present some of the more important considerations to be given in control of maintenance and operation. With respect to water-supply improvements, the following appear to be necessary:

1. Local ordinances and regulations must be enforced to prevent contamination of water supplies by encroachment of privies, cesspools, and other sources of contamination, and in addition regular patrol of the watersheds of surface-water supplies should be maintained.

2. Water purification and treatment plants should be operated under the supervision of a competent and experienced person, with analytical control of operation, and daily records should be maintained and submitted to the State department of health, which department should have the power to require changes in operation, as may be necessary.

3. The maintenance of storage and impounding reservoirs, wells, conduits, receiving basins, distributing reservoirs, standpipes, and other portions of a waterworks system, should be subject to the

direction of the State department of health, and when necessary orders should be issued and enforced requiring necessary changes and improvements in maintenance and operation.

4. A frequent menace to the safety of a water supply is the existence of connections on the distributing system to premises for which independent water supplies of unsafe quality are maintained. Interconnections of this kind should be prohibited by State or local regulation.

5. As the benefits of a good water supply can not be realized fully unless such supply is universally used, local regulations should be enforced, requiring connection to the mains and abandonment of private wells and other unsatisfactory sources of water supply.

6. Frequently the wastage and leakage of a water supply results in overburdening a purification plant or other equipment and rendering the water supply inadequate. Restrictions upon wastage and leakage should be enforced by local regulation.

The following considerations are of importance in regard to maintenance and operation of sewerage improvements:

1. However carefully a sewerage system is designed, its benefits can not be realized unless it is used properly. Local ordinances and regulations should be enforced, requiring sewer connections, providing for control of the establishment of sewer connections and prohibiting misuse of sewers, such ordinances to be approved by the State department of health before they are enacted.

2. A trouble of frequent occurrence is the clogging of connections from combined sewers to intercepting sewers, resulting in the passage of the dry weather sewage flow through the storm-water outlet. Efficient and regular inspection by the local sewer department is necessary and should be required.

3. The maintenance and operation of sewage pumping and treatment equipment are very frequently neglected, and as the duties connected with such work are usually distasteful to the public officials, there should be adequate legislation permitting the State department of health to require by proper orders the necessary maintenance and operation of such improvements.

ENFORCEMENT OF ORDERS REQUIRING IMPROVEMENTS.

In addition to legislation providing State control of proposed and existing improvements, it is necessary that legislation be provided to permit the application of the police power of the State in enforcing the installation of sanitary improvements which are necessary to protect the public health. If such legislation does not exist, there is no means of requiring correction of impure water supplies and of stream pollution, except upon the initiative of the municipality or persons who are responsible for the maintenance of the unhealthful conditions. Legislation should be enacted which will permit orders to be issued and enforced by the State department of health, covering the following cases:

1. Requiring the installation of improvements to provide an adequate and safe water supply in case the public health is endangered by the absence of a supply, the maintenance of an impure supply, or the maintenance of an inadequate or unsafe system.

2. Requiring the installation of sewerage and improved sewage and industrial waste disposal in case the public health is endangered by the absence of sewerage, the maintenance of inadequate or unsatisfactory system, or the improper disposal of sewage or industrial wastes.

3. Requiring the extension of water mains and sewerage when necessary to protect the public health.

It is important also that such legislation provide means whereby the funds can be secured for the carrying out of such orders. If there is a statutory limitation on indebtedness of political subdivisions of the State, the legislation should include exemptions by which the necessary funds can be raised outside of the statutory limitations.

I have endeavored to outline as completely as possible the principal features of State control of sanitary improvements which are necessary to provide effective supervision. It is recognized that the features as outlined cover a broad field and that it may be impossible to undertake all features of State control at the same time. It is believed, however, that complete State control will ultimately be found advisable and will eventually be adopted in any State which attempts partial control of sanitary improvements. The carrying into effect of State sanitary control, either on a partial or on a complete basis, will necessitate the maintenance of an efficient engineering organization and will require untiring effort on the part of the individuals forming such organization if good results are to be secured.

WATER QUALITY CONTROL.

William Firth Wells,

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Any comprehensive program for the conservation of water—our greatest natural resource—must recognize the primary value of quality in water. Whereas development of navigation, irrigation, and water power is possible by control of the available quantity of water through regulation of the flow, its value for water supplies, industrial purposes, fisheries, recreational purposes, and waste elimination depends upon the control of the quality of water by the regulation of wastes. "In considering the uses of water and consequently the expenditures which may be made in conservation by storage, we may divide these uses into five classes: First, support of life; second, production of food; third, carrying away wastes; fourth, manufacturing, including water power; fifth, navigation."[1]

Biological and chemical problems, as well as engineering, are important considerations in the first four classes, and efforts have been made to prevent, as far as possible, injury to the value of water which depends upon its quality.

Lack of systematic effort is the principal reason for the slow progress in the elimination of pollution. Quality control is as definite as the inverse problem of regulation of flow. The positive value received in the use of a stream for waste disposal is the saving of a negative value—the cost of treatment. The problem is one of regulation rather than prohibition, for no one standard can apply to waters used for various purposes nor is a uniform treatment of wastes demanded under differing conditions.

If the accumulated chemical knowledge of the requirements of water were expressed in comparable quality units, much existing confusion would be eliminated. Since all wastes are harmless in sufficient dilution and the dilution possible in a stream without injurious effect determines the permissible limits of pollution, it is suggested that dilution be accepted as the fundamental quality unit of measure. The dilution equivalent or effective dilution of treatment processes can be defined in the same terms, when it becomes possible in any given case to determine very simply the relation existing between the requirements demanded and the means and cost of solution. Such a simple system of common understanding would be a most important factor in a united quality conservation program.

There are evidences that the time is approaching when different forces will unite to cooperate in one general harmonious program. The report of the Royal Commission on Sewage Disposal of Great Britain vividly portrays the necessity for such central direction, and in a general manner the recommendations indicate the only effective means by which progress can be directed. While it is not necessary to officially unite the multitude of agencies concerned in and working upon the problem, it does seem essential that some central authority be responsible for guiding efforts toward harmony.

In New York State the conservation commission can logically take this broad interest in the pollution of waters. By recognizing quality control by the regulation of wastes as a conservation problem, analogous to regulation of stream flow, the commission can fulfill many needs in making water protection more effective. In this way an intermediary cooperative agency is created capable of developing the greatest value of individual effort.

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[1] "Water Resources—Present and Future Uses." (F. H. Newell.)

Under the present conservation law the commission has a broad jurisdiction over the quality of waters and an effective machinery for enforcing the law. All sewerage applications must be approved by the commission. The equitable distribution of water-supply resources is effected by issuing permits. Under the division of fish and game an efficient force of protectors is continually patrolling the streams, which is always alert to enforce such administrative regulations as prevent the destructive abuse of the waters. The commission also maintains numerous hatcheries where fish are propagated for planting in State waters, so as to overcome the natural depletion brought about by increased fishing. In the last few years the legislature has made an appropriation for the investigation of the effects of pollution and means of remedying the same, thus enabling the commission to enforce these laws intelligently.

A specific administrative program has been adopted for guidance in the work. Even with the incomplete knowledge at present available, much can be accomplished in administrative action. The following classification of wastes demanding similar administrative action has been taken from this program:

TYPE I.—INNOCUOUS WASTES.

Innocuous wastes are those that do not appear to be sufficiently detrimental to require action by the commission. Under the provisions of the law the commission has an opportunity to examine all new cases of this sort as they arise, and if it finds that they are, in fact, innocuous no further action than the granting of a permit is necessary. In the case of existing industrial establishments it is necessary only for the commission to determine their innocuous character.

TYPE II.—SANITARY SEWAGE.

Sanitary sewage is in many cases extremely detrimental from every standpoint, the most important objection to it being its effect upon public health. The State department of health is making excellent progress in bringing about the installation of sewage-disposal plants operated by municipalities. The pollution of the streams of the State by sanitary sewage is on this account decreasing at a very satisfactory rate. The commission has jurisdiction over pollution by sewage as affecting potable waters, fish hatcheries, and fish or shellfish in the marine district. The commission will, wherever possible, cooperate with the department of health in such cases and in general educational work to encourage the proper handling of sanitary sewage by municipalities. Sanitary sewage would not be classified under this type if mixed with so great an amount of detrimental trade waste that the latter becomes the controlling factor, thus putting that particular case of pollution into Type III, or IV, below.

TYPE III.—PROHIBITED WASTES.

Certain kinds of waste are so detrimental even in great dilution that they should, in general, not be allowed to enter public waters. Often these wastes are produced in the course of manufacturing processes independently of the use of the water. The practice heretofore has nevertheless been to dispose of them by finally turning them into the stream as the easiest method of their disposal. It is clear that the simplest method of preventing the injury due to these wastes is to exclude them completely from the stream. This can usually be done with facility and often with profit to the industry.

The prohibited wastes may be divided into two subtypes as follows:

A continuous prohibited waste.—This subtype of prohibited wastes consists of those that are discharged with such frequency as to produce in the stream a more or less constant intensity of pollution. Biologically, evidence of their presence is usually found in partial or total absence of life in the polluted section of the streams at all times. The best example of this type of pollution is the discharge of sawdust into a stream.

A periodic prohibited waste.—This subtype includes those wastes that are not a continuous daily product of an industry, but that nevertheless reach the stream from time to time, either intentionally or by accident. There may be abundant fish and other aquatic life in a stream for a long period, but upon periodic prohibited waste being discharged, there is usually a large and sudden mortality of fish. There may then be time for the stream to recover, partially or wholly, before another discharge of the pollution. An illustration is a pile of spent carbide from an acetylene gas plant, poisons from which reach the stream only when rain falls and leaches through the carbide. The periodic dumping, either intentional or accidental, of such wastes into public waters is a frequent cause of great and conspicuous destruction of fish.

TYPE IV.—TRADE WASTES REQUIRING TREATMENT.

A great many trade wastes, which prove detrimental when untreated, are capable of such treatment that the resulting effluent is innocuous. The wastes under this type are usually those introduced into the water through the use of the water in the actual processes of manufacture. This means that such wastes, because of their admixture with large quantities of water, must undergo a treatment process for the purpose of removing them from the water before the water is returned to the stream, or rendering them innocuous without actual removal from the water. In some of these cases a bi-product may be obtained as the result of treatment, which has an actual, financial value.

Two subtypes are recognized as follows:

A. *Wastes requiring treatment known, practicable and effective.*—The best illustration of a waste under this subtype would be sanitary sewage except that, on account of the limited jurisdiction of the commission over such pollution, it has been classed as a special type. The commission proposes to study, or encourage the study of, methods of treating wastes, and the result of carrying out this part of the program will be to enlarge the number of wastes coming under this type. While the handling of cases of pollution under this subtype presents problems of a scientific nature, the chief task is the administrative one of securing treatment.

B. *Trade wastes requiring further study.*—The method of treatment of many detrimental trade wastes, which it is impracticable to dispose of otherwise than by running into streams, is not fully worked out. The wastes in this subtype are so many, and the damage that they do is so extensive, that their gradual elimination must constitute one of the most important and difficult phases of the work. Here, as at other points throughout this program, one of the guiding principles to be followed is that of directing action toward ends that are possible of accomplishment without serious detriment to industry. For instance, there is the question whether the wastes of a particular industry can at the present time not be excluded from public waters or made innocuous without a serious impairment of that industry. This plan contemplates that the industry be advised that it is violating the law and that the responsibility for studying methods of purification of its wastes rests upon it. The commission will cooperate with the industry to the end that required purification be brought about in every possible and proper manner.

COORDINATION OF THE CONTROL OF DRINKING WATER ON INTERSTATE CARRIERS WITH ENGINEERING FUNCTIONS OF STATE DEPARTMENTS OF HEALTH.

C. M. Baker,
State Sanitary Engineer, Wisconsin State Board of Health.

The certification of water supplies of interstate carriers by the United States Public Health Service, in cooperation with the various State boards of health, has been a matter of considerable contention for a number of years. In certain States the laboratory procedure has not precisely conformed to the standards of the Treasury Department and the State officials have not felt justified in modifying their methods so as to meet these requirements. Furthermore, some of these States have made rather complete sanitary surveys of their public water supplies, which, together with the analytical data, furnish more definite information on which to judge the quality of the supplies than that required by the Treasury standards; nevertheless their methods have not conformed entirely to these standards. Other States have practically no facilities for either obtaining analytical data or making sanitary surveys. In view of these discrepancies, difficulties have been encountered by the Public Health Service in securing satisfactory certification of water supplies of common carriers. Various modifications of the required procedure have, therefore, been made by the service from time to time.

The Act of Congress which provides for the control of water supplies of interstate carriers entitled "An act granting additional quarantine powers and imposing additional duties upon the Marine Hospital Service," was approved February 15, 1893. Section 3 of this act provides "That the supervising Surgeon General of the Marine Hospital Service shall * * * examine the quarantine regulations of all State and municipal boards of health and shall * * * cooperate with and aid State and municipal boards of health in the execution and enforcement of the rules and regulations of such boards and in the execution and enforcement of the rules and regulations made by the Secretary of the Treasury to prevent the introduction of contagious and infectious diseases * * * into one State or Territory or the District of Columbia from any State or Territory or the District of Columbia." It further provided that if the local regulations are inadequate the Secretary of the Treasury shall "make such additional rules and regulations as are necessary to prevent the introduction of such diseases," which shall be enforced by the local authorities except in case they decline to assume these duties or fail in their execution when the President shall execute and enforce the same.

In conformity with the provisions of this act the Surgeon General of the United States Public Health Service, through the Secretary of the Treasury, has promulgated interstate quarantine regulations which include regulations for the control of water supplies on interstate carriers. These regulations required that the water conform to the "bacteriological standard of purity for drinking water supplied to the public by common carriers in interstate commerce," which was promulgated by the Secretary of the Treasury on October 21, 1914. These standards outline a definite procedure in analyses for the determination of B. coli and the total bacteria on agar at 37°. Since this paper is to discuss mainly the engineering functions, however, only the requirements of these rules will be stated, namely, that the water should not contain more than 100 bacteria on the agar plate at 37° nor in excess of 2 B. coli per 100 c. c. No provision was made for deviation from this standard nor was any sanitary survey required, the quality of the water being passed upon by analyses only. With reference to handling water certain requirements were made regarding the use of clean ice, cleaning the containers, etc., but the ice was allowed to come in contact with the water itself. An amendment of these rules and regulations was later enacted on February 12, 1917, the requirements of which, however, were substantially the same as those of the previous regulations except with reference to the procedure of the common carriers in securing certification of the water.

It should be borne in mind that these early regulations were put into force at a time when few if any of the States had adequate facilities for proper control of their water supplies by sanitary surveys, and that in many cases even suitable laboratories were not available. In fact, a survey of the facilities of the various States for the control of water supplies by the United States Public Health Service early in 1919 showed that less than one-half of the States were well equipped for this work, 12 of the remainder had no sanitary engineers, but were equipped with meager laboratory facilities, while one State had neither an engineer nor laboratory. It is obvious, therefore, that although some States are well qualified to control their own public water supplies, and in connection therewith those of all common carriers, general control by the United States Public Health Service is still essential. The purity, not only of public water supplies, but also of those of common carriers within the State, should, however, be of prime interest to the State itself, because of the great danger to the inhabitants thereof when these supplies are impure.

On account of the value of sanitary surveys, and for the purpose of securing better coordination of this work between the States and the Public Health Service, the rules and regulations were again amended on July 14, 1919.

This new amendment requires that "water provided for drinking and culinary purposes * * * shall be from a source which is certified and approved as producing water of satisfactory quality and safety," the certificates are to be based upon freedom from contamination, as determined through a sanitary survey and the results of the bacteriological and chemical analyses, by methods approved by the United States Public Health Service. These certificates of examination may be issued by officers of the service or by the State departments of health, and shall be filed semiannually in March and September of each year, except where constant supervision of the supplies is maintained by the State authorities, in which case annual certification may be approved by the Surgeon General. The water shall be so handled as to prevent pollution and shall be cooled in such a manner that ice can not come in contact with the water.

"Recommendations regarding data upon which certification is based" are printed upon the back of the standard form of certificate and recommend—

1. "Standard method of water analyses," A. P. H. A.
2. That both data of the sanitary survey and the analyses be recorded on the certificate where available, although "certificates based upon only bacteriological or chemical data, respectively, may be submitted with the approval of the Surgeon General."
3. That the regional "normal" be given with chemical analyses.
4. The method for bacteriological analyses promulgated by the Secretary of the Treasury on October 21, 1914, be used for the average supply.
5. Favorable certificates based upon bacteriological data not conforming to this standard "must particularly show in the sanitary survey data reasons wherefore such excess is believed to be without sanitary significance."

The new rules and regulations, therefore, largely eliminate the old objection since more latitude is given the various State officials in their method of control, provision being made for basing interpretation of the analytical results upon sanitary surveys also for modification of the methods of analysis. The requirement that the supplies of common carriers be certified semiannually in March and September of each year, however, seems somewhat impractical, because it is impossible in many States to make the necessary sanitary surveys within one month's time, and unless this is done the certificate must be based upon obsolete data.

It is believed that the control of the water supplies of common carriers as well as of all public supplies should be mainly if not wholly under the supervision of the respective State departments of health, providing these departments are adequately equipped for such control. The equipment for this control should consist of a well organized and efficient division of sanitary engineering which should have direct supervision of water supplies as well as of other engineering matters. Either as a part of this division or cooperating with it should be a water laboratory. The engineering personnel should be sufficient to make annual sanitary surveys of all groundwater supplies and more frequently when there are potential dangers of pollution also, quarterly sanitary surveys of all surface supplies or where purification is necessary, except in case municipalities themselves maintain satisfactory scientific control. In connection with all these surveys samples should be collected for analysis, and in some cases more frequently. It is generally conceded that a sanitary survey is essential for intelligent interpretation of water analyses. The analytical results should, therefore, in order to prevent discrepancies between the two divisions, be transmitted to the engineering division for interpretation and not sent directly to the local authorities from the laboratory.

There are three points that we have endeavored to bring out in this paper, which may be summarized as follows:

1. The present regulations governing the certification of water supplies of persons, firms, or corporations engaged in interstate traffic provide a satisfactory basis of cooperation between the United States Public Health Service and the various State officials, except that certification should not be confined specifically to the months of March and September.

2. As soon as a State has adequate facilities and is ready to assume control of these supplies, however, they should be given complete control over them.

3. In those States where such facilities are not available, the United States Public Health Service should retain control and, in cooperation with State officials, should endeavor to build up the necessary organization. In this connection, the service should be in position to furnish engineering and laboratory personnel to assist these States. In connection with this work, assistance could be given not only in the control of water supplies of common carriers but also in building up effective State organizations for the control of sanitary conditions generally within the State.

THE SANITARY PROTECTION OF SHELLFISH.

RICHARD MESSER,
Chief Engineer, Virginia State Board of Health.

In the short time of 15 or 20 minutes allotted, it is possible to give only a brief outline of the problem and to call attention to the certain matters which from now on should be given serious consideration by the members of this section. Investigations of shellfish areas and the methods of handling during the past 10 years will serve as a basis for future policies. Although the direct supervision of the industry must necessarily fall on the health officials of those States bordering on the coast, nevertheless, the subject is of national interest because of the wide distribution of these food products.

Most of you are familiar with the reports by the Public Health Service covering the detailed and comprehensive investigations made under the direction of Surgeon (now Surgeon General) Cumming; the first one of the pollution of the Potomac River and since then of the coastal waters from Virginia up to New York.

The magnitude of the industry and its relation to the economic interests and health of the country may be indicated best by quoting a few statistics. In Chesapeake Bay and its tributaries there are approximately 800 square miles of oyster-bearing areas, from which there are taken each year at least 15,000,000 bushels of marketable oysters, valued at $15,000,000. Next in importance are the areas bordering New York State and then the grounds in Delaware Bay and along the New Jersey coast. There are also holdings along the Atlantic south of Virginia and the waters of the Gulf.

The subject of sanitary protection may be discussed under two separate heads, first the purity of the waters from which the oysters are taken for market purposes and second, the care in handling and packing. This paper is limited principally to the discussion of the first of these, which involves questions of sewage treatment, self-purification of streams, and tidal flows, which are essentially problems of an engineering nature.

As is brought out clearly in the reports above referred to, oyster beds may be listed in three general classes, (1) those located at some distance from the shore line and having a depth of water ranging from 15 to 50 feet; (2) grounds in tidal estuaries, at the mouths of creeks and near shore, with depths of water not exceeding 15 feet (the maximum depth in which tongs can be used effectively); and (3) areas in the larger rivers, such as the Potomac, Delaware, and the James.

The relative probability of pollution of the coastal waters in the first two classes is best indicated by quoting from Dr. Cumming's of health, providing these departments are adequately equipped for such control. The equipment for this control should consist of a well organized and efficient division of sanitary engineering which should have direct supervision of water supplies as well as of other engineering matters. Either as a part of this division or cooperating with it should be a water laboratory. The engineering personnel should be sufficient to make annual sanitary surveys of all groundwater supplies and more frequently when there are potential dangers of pollution also, quarterly sanitary surveys of all surface supplies or where purification is necessary, except in case municipalities themselves maintain satisfactory scientific control. In connection with all these surveys samples should be collected for analysis, and in some cases more frequently. It is generally conceded that a sanitary survey is essential for intelligent interpretation of water analyses. The analytical results should, therefore, in order to prevent discrepancies between the two divisions, be transmitted to the engineering division for interpretation and not sent directly to the local authorities from the laboratory.

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SUPERVISION OF SHELLFISH AREAS IN VIRGINIA.

In Virginia the State board of fisheries is charged with the conservation and protection of all shellfish areas and the State dairy and food department is required by a special act to examine areas and establish limits of pollution and to issue certificates covering waters which are safe.

At the present time the commissioner of fisheries has the personnel and facilities for the effective control of shellfish removal either by transplanting of seed oysters or the taking of oysters for market purposes. The law requires that transplanting from public rock situated within a polluted area to cultivated beds shall be done between May 15 and August 15. With regard to private grounds, transplanting is done by permit, which provides that the oysters shall remain in pure water at least seven days before being taken for market purposes.

From this it will be noted that the State board of health has practically no authority over this industry. In 1916, an effort was made to secure the passage of an act to regulate the disposal of sewage, but without success. Since then there has been a decision rendered by the Virginia Supreme Court and confirmed by the United States Supreme Court which is of vital importance to the industry not only in Virginia but perhaps in all the States. A brief summary is given as follows:

Summary of decision by Virginia Supreme Court of Appeals Darling *v.* Newport News (123 Virginia, 14—June–November, 1918:

> There is a marked and well defined distinction between the pollution of a small nonnavigable stream and the pollution of large tidal navigable bodies of salt water for the reason that in the first case the bed of the stream and the waters are owned by riparian owners, while in the latter case the bed of the navigable tidal salt water and the waters themselves are owned and controlled by the State, for the use and benefit of all the public, subject only to navigation. It is for the State to say what uses shall be made thereof and by whom, subject always to the right of the public, and for the State, through the legislative branch of the government, to say how much pollution it will permit to be emptied into and upon its waters so long as the owners of the land between low water and high water marks are not injured.
>
> A municipal corporation situated on the arm of the sea, adjacent to tidal water, has the right to use such waters for the purposes of carrying off refuse and sewage to the sea, so long as such use does not create a public nuisance, and any injury occasioned thereby to private oyster beds is damnum obseque injuria.
>
> The power of the sovereign State or Nation is perpetual, not exhausted by one exercise and all privileges granted in public waters are subject to that power, the exercise of which is not the taking of private property for public use, but only the lawful exercise of a governmental power for the common good.

The decree goes on to say that any leases granted for the planting or propagating of oysters in tidal waters do not in any way disturb any prior State rights with regard to the use of waters for the discharge of sewage and wastes, etc.

This case was argued in the United States Supreme Court on April 15, 1919, the decision being summarized as follows:

> Generally speaking, private rights in land under tidal waters are subject to the right of the State to use such waters as a depository for sewage.
>
> Plaintiff held oyster beds in the tidal waters of Hampton Roads by leases from the State of Virginia, under whose laws, as long as he paid rent, he was declared to have the "exclusive right to occupy" the land for 20 years, subject to any rights of other persons previously acquired, with the State's guaranty of the "absolute right" to continue to use and occupy it for that period. Held: That the grant, construed strictly, with reference to the public necessity in that vicinity and previous pollution of the water, was subject to the right of the State to authorize the city of Newport News to discharge its sewage into the Roads, and that the consequent pollution of the plaintiff's oysters was neither (1) taking of his property without due process; nor (2) an impairment of his contract rights; nor (3) (following the State court) a damage in the sense of the Virginia Constitution which requires compensation for property taken or damaged for public use.

The above decision, of course, is a serious blow to many of our oyster planters, as in all probability some of their most valuable holdings may have to be condemned within the next few years as the quantities of untreated sewage from nearby cities increase. The thought occurs to me that the question of the purity of waters over oyster areas is very similar to that of public water supplies. A few years ago there was a tendency to treat all municipal sewage in order to maintain the purity of streams from which public water supplies were taken. Since then many of the States have adopted the policy of requiring only such treatment of sewage as is necessary to prevent any danger of overloading the water purification plant below. The water purification plant is what is relied upon to produce a safe and satisfactory supply.

For the same reason why should not oysters be purified by cleaning in pure water just before being packed for shipment. If a practical scheme can be devised it may mean that the standards concerning the bacterial quality of the waters over the beds may be changed somewhat. Of course, under no circumstances should oysters for market purposes be taken from grossly polluted beds no matter what method of purification is used. On the other hand, it would not be necessary to condemn an area which is only slightly polluted as indicated by bacteriological examinations.

The problem of working out a plan by which oysters can be cleaned in basins of artificially purified water should not be difficult. In its simplest form the plant would include a basin in which chlorinated water would be kept in constant circulation by means of pumps. The arrangement might be very similar to the one adopted for swimming pools in which the same water is used for a number of days and sometimes several weeks. At any rate the results of experiments which have already been made are so good as to justify further study as to details and costs.

MOSQUITO CONTROL AS AN ENGINEERING UNDERTAKING.

SOL PINCUS,
Associate Sanitary Engineer, United States Public Health Service.

THE IMPORTANCE OF MOSQUITO CONTROL.

The mosquito problem is of national scope and is a social-economic as well as a public health problem. As the agent of the spread of malaria and other protozoal diseases, such as yellow fever, dengue, and filariasis, the insect is the cause of the crippling and debilitation of hundreds of thousands of people annually in this country, and directly or indirectly of the death of not a few score thousands of these. The sum of the economic losses to this Nation due to the ravages of malaria, in view of the long, often interminable periods of enervation of the persons attacked, is probably second to that of no other disease, excepting only the recent pandemics of influenza. In the State of Mississippi there were reported, in 1916, 158,751 cases of malaria and 1,426 deaths, from which it was estimated that more than 400,000 cases of malaria were actually occurring each year in that State amongst a population of 2,000,000; an average of one person in each five is annually attacked. For comparison it may be stated that an estimate by Mr. George A. Johnson for typhoid fever for this same period was 200,000 cases annually in the whole country. It is well-nigh impossible to gauge the extent of malarial infection throughout the land which some would place around three-fourths to one million cases per year. The disease is definitely known to be endemic in pretty nearly a third of the area of the United States. The damage wrought by malaria in impaired working ability and decreased social-economic values is enormous. Senator Harris, of Georgia, an able economist and former member of the Federal Trade Commission, places the economic loss to the country due to malaria at $1,000,000,000 annually. Mosquitoes, besides being the greatest known disseminators of disease, are an additional curse to humanity in the amount of annoyance and nuisance that their prevalence causes the human being. It becomes a matter of the utmost importance for the development of a region for industries or habitations that it be made virtually free of the mosquito pests. In sections of the North and East, where malaria is uncommon, it is not an unusual occurrence to hear of construction efforts handicapped and delayed by the interference of mosquitoes, or of important residential locations and pleasure resorts suffering from and being discriminated against because of the presence of these insects. As the people of this Nation progress in the demand for improved and more efficient conditions for labor and living this nuisance phase of the mosquito-control problem will call for greater and greater consideration.

In short, the prevalence of these insects in any area means that the section is unhealthy and unsuited for the dwelling of human beings, it can not be prosperous nor will it be tenanted by successful people able to move elsewhere, while those remaining will be most inefficient workers struggling vainly under grossly adverse conditions.

It is apparent therefore that mosquito control is a proposition of more significance, and is more fundamental than is commonly supposed. Its successful handling is now largely a responsibility of the engineers of the country. It is a problem that the engineer must take responsibility for, because the many activities of the engineer, such as the building of railroads, highways, impounded reservoirs, lumber mills, canals, etc., have greatly determined the extent and controllability of mosquito propagation—only too often have works as just mentioned very considerably extended and aggravated the malaria and mosquito problem. Dr. Carter once stated that for every dollar spent on roads in malarial regions of the South there has been 25 to 50 cents of harm done to public health. The control of mosquito propagation is fittingly an engineer's problem, as the sanitary engineer in his training, combining biology, physiology, and chemistry with civil engineering, is the one best qualified for the institution and development of works to combat the prevalence of the pests. The preliminary information and facts regarding the life habits of the insects and their exact relation to the spread of disease have had to be furnished by the pathologist and biologist, but to-day when it is a matter of the economical development and establishment of practical means for the control of the mosquito propagation, the problem is one very largely for the engineer.

The histories of mosquito campaigns have now firmly established the practicability and importance of the elimination of mosquitoes and the skilled technical services that are required. Cuba and Panama remain shining pioneer examples of the successful results of antimosquito works—carried on under most adverse natural conditions by which the ubiquitous stegomyia, the yellow-fever carrier, were eliminated, and the settled areas practically freed of all species of the pests. In these campaigns, engineers, who had first to be trained in this field, were placed in charge of the execution of the preventive measures. The recent Great War has produced no more emphatic lesson in sanitation than in the demonstration of the possibilities of malaria-free and mosquito-free camps in the midst of malarial and marshy surroundings. The results of a thorough and continuous fight against the malarial mosquito made it possible for the Army to achieve the record in the reduction of malarial fever cases and deaths which it has—a total of 14,087 admissions and 31 deaths from malaria taking place during the war period of 1917 and 1918, which is a percentage reduction of 99.07 per cent of cases and 99.74 per cent of deaths from the rates obtaining in the Civil War, and 99.26 per cent of cases and 99.45 per cent of deaths from the rates during the Spanish American War. In the civilian zones about the military camps over 40 engineers of the Public Health Service were directing the fight against the mosquito and thousands of laborers and millions of dollars were used in providing proper drainage, oiling, and in other combative measures. Within the military zones many times this number of engineers were engaged with larger forces and bigger funds in this war against a tiny but deadly enemy of democracy and humanity.

A description of the varied measures and control works that are used by the engineers in the carrying out of antimosquito activities would be rather lengthy. I will attempt to do but little more than enumerate them here. At the very first, a survey and inspection must be made of the region to be controlled, the nature of the watercourses, geological characteristics of the locality, the places in which breeding are found or considered likely to occur and the locations where adult insects are encountered, which are all indicated on a chart plotted of the section. Usually the next step will be to study what the treatment of the different areas will be; a determination of the costs is then worked up, which will be followed by a test of one's sanitary statesmanship in obtaining the requisite financial and popular support. With the funds and authority provided, the building up of an organization of laborers, inspectors, and assistants is commenced. The problem of securing the most suitable transportation for the men and materials will generally require some earnest attention. The actual carrying out of the antimosquito work will be found to consist of two kinds—one, the constructive measures; that is, those requiring building and digging operations mostly in connection with provisions for improved drainage; and the second, the strictly control measures which will include the oiling, fish stocking, and inspection.

Of the so-named constructive measures, the principal one may be said to be the construction of proper drainage lines. These are generally planned as a system of intercepting and lateral lines of ordinary open earth ditches or canals, but provided with steeper side slopes, sometimes even to a perpendicular, and with the sharpest obtainable invert section. Great attention must be given to the grade of these mosquito ditches in order that they may be self-scouring. In the work on tidal marshes these ditches are more strictly connecting lines and are often dug by light, self-propelled ditching machines which dig a very narrow trench a few inches in width and with perpendicular sides. In some instances, as on farms or in seepage areas within towns, open ditches, which are always more costly in upkeep, are also inadvisable even as temporary measures, and then permanent drainage by tile or lined drains is installed. In very soggy, mucky areas the construction of ditches by blowing them out with dynamite has been found most economical. In connection with the drainage operations there will usually be a vast amount of clearing and stump removal to be done from alongside stream banks and in wet areas. Added to the usually great natural obstacles, there will be frequently many man-made interferences to be overcome, such as railroad embankments, poorly planned culverts, deep borrow pits, pipe lines, log jams, etc. In some cases vertical drainage by means of shafts sunk to porous strata beneath the surface is found successful for getting rid of the water.

Again, on tidal marshes methods are employed whereby a dike shuts out the water at ordinary tidal levels and by means of tide gates the ground surface is unwatered.

In the case of bodies of impounded water, lakes, ponds, and pools, where complete drainage is usually not feasible the treatment accorded is usually the destruction of the vegetation at the water edge and on the water surface by stripping or use of subaqueous saw, by varying the water level, and then by effective control measures.

These control measures, as I have grouped them, consist of auxiliary means to prevent the propagation of mosquitoes when the body of water is not drained or carried off. This is usually accomplished by various schemes for the application of oil or larvacide to the water. Spray pumps, drip cans, oil soaked sawdust, and waste are used, and also stocking the water with top-feeding minnows. In some instances a large reservoir may be kept from breeding mosquitoes by the agitation and wave action produced by a motor boat circuiting the basin, while in other instances sewage tanks may be prevented from breeding by building tight screens and superstructures which would exclude the adult insects. Finally, the frequently overlooked breeding source in artificial containers, cisterns. catch basins, rain gutters, nondraining roofs, fire barrels, and tin cans must be watched for and treated by routinely destroying the hatching larvæ, or better still, the removal of those sources as accessible breeding grounds.

The above outline must impress one with the wide range of technical phases to the mosquito-control problem, which vary from the determination of the viscosity and toxicity of the oil to be used for preventing breeding in a fire barrel to the planning and installation of a drainage system of main canals, intercepting and lateral ditches to unwater thousands of acres of marshland.

Constructive operations on a large scale for the elimination of malarial and other mosquitoes are reported planned and partly under way in all parts of the world—in the highly malarial regions of Italy and the Balkans, in the newly reconquered lands of Palestine and Asia Minor, in Africa and South America, and even in England, where a serious renaissance of malarial epidemics is threatened due to the presence, because of the war, of numerous infected carriers.

In this country, State and local compaigns have been instituted against the malarial mosquito in nearly all of the Southern States, notably in Arkansas and Mississippi, and against the general mosquito nuisance in some eastern States, as New York, Pennsylvania, and New Jersey. New Jersey has developed extremely effective methods of combating the salt-marsh mosquitoes, and proposes to spend three-fourths of a million dollars to rid the State of its far-famed, pestiferous product. Though some work has been begun to reduce the malaria and mosquito damage in this country, it can so far scarcely be considered more than a demonstration—and usually a most successful demonstration—while much remains to be done to make a good sized commencement in the elimination of malaria and mosquito troubles.

What is imperatively needed is a program for the widespread organization of antimosquito drainage districts, fostered and stimulated by State and Federal agencies, whereby an organized permanent effort in the various localities could be made against the prevalence of the mosquito. New laws curbing the production of mosquito-breeding areas must be instituted and money grants obtained for the stimulation and assistance of this work. In the campaign for this end the engineer must take a leading part, and especially the engineers in administrative public positions. There must be found technical men who are willing to become qualified by training and study to take directing places in the undertaking of this large country-wide antimosquito work. Though perhaps this work is most times devoid of monumental evidences of the struggle and the constructive efforts frequently to be had at the completion of engineering projects, there still remains in my mind the belief that in hardly any other field of engineering activity is there work to compare with the possibilities for great service in the prevention of human suffering as in the campaign of malaria and mosquito control.

The damage and harm has been going on for countless ages; to-day we have the demonstrated means, effective and economical, for relief; only a blind humanity will ignore and refuse to make use of them.

After a discussion of the papers, the conference adjourned.

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